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SCIENTIFIC CONTRIBUTIONS OF THE
NEW YORK ZOOLOGICAL SOCIETY
ON THE DISEASES OF ANIMALS



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VOLUME I, NUMBER 1

SOME NEW SPECIES OF PARASITIC TREMATODES OF MARINE FISHES

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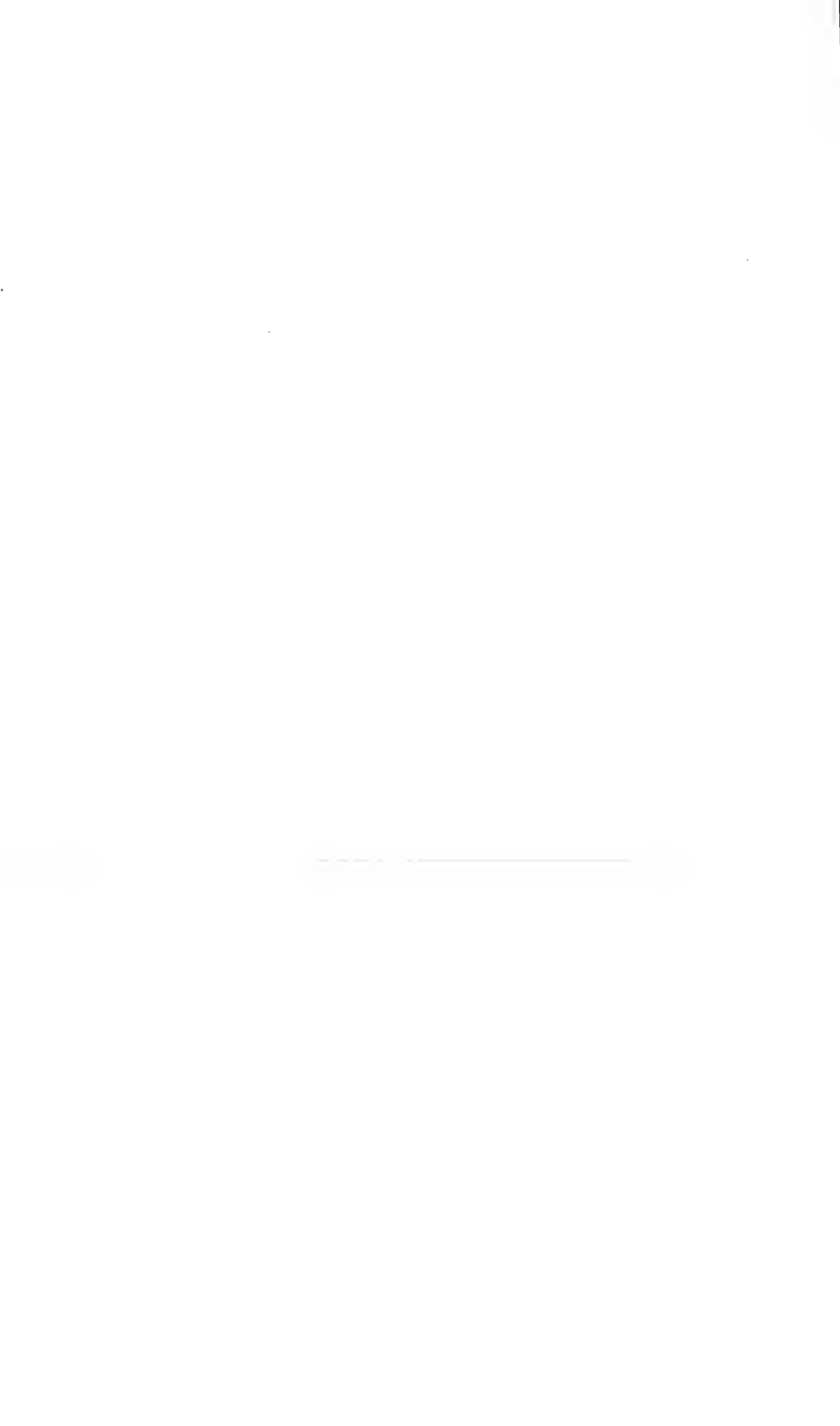
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ERRATA

plurovitellum should read *plurovitellum* wherever it occurs.
Merlucius should read *Merluccius* wherever it occurs.
merlucii should read *merluccii* wherever it occurs.
hematobium should read *hematobia* wherever it occurs.
 On page 28 the width of Chitinous Cirrus should read .015.

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ABBREVIATIONS

Abbreviations in explanation of plates :

b.s.—buccal sucker	ov.d.—oviduct
c.s.—caudal sucker	ph.—pharynx
c.p.—cirrus pouch	p.p.—pars prostatica
cl.—cloaca	pr.—prostate
c.—cirrus	r.p.—reservoir prostatica
b.ej.—bulbus ejaculatorius	p.s.—penis shell
d.ej.—ductus ejaculatorius	s.g.—shell gland
e.—eye	s.v.—seminal vesicle
ex.p.—excretory pore	s.r.—seminal reservoir
ex.v.—excretory vessels	s.p.—sensory papillae
g.p.—genital pore	t.—testis
g.a.—genital atrium	t.a.—tactile area
h.—hook.	u.—uterus
i.—intestine	u.g.—unicellular glands
m.—mouth	v.d.—vas deferens
m.b.—muscular bands	va.—vagina
m.g.—mucus glands	vit.—vitellaria
met.—metraterm	v.s.—ventral sucker
o.s.—oral sucker	v.r.—vitelline reservoir
ov.—ovary	w.v.s.—water vascular system
oot.—ootype	y.d.—yolk duct
oe.—oesophagus	y.r.—yolk reservoir

SOME NEW SPECIES OF PARASITIC TREMATODES OF MARINE FISHES

BY G. A. MACCALLUM, M. D.

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Pathologist to the New York Aquarium.*

INTRODUCTION

In presenting the following papers, it is desired to say that the forms from marine biological life which are herein described were studied in material from the New York Aquarium and the United States Fish Commission Laboratory at Wood's Hole. However imperfect the descriptions may be, the plates that are used are from sketches made by the author from life and from mounted specimens in our collections, and we believe them to be as true to nature as it is possible to make them. Other than the outlines of the form of the worm, the studies are of the reproductive organs; inasmuch as there is little else to show in the bodies of these hermaphroditic creatures, whose whole object in life seems to be the reproduction of their kind.

From the material above described, the able artist, Mr. Feinberg, has shown in a very realistic way all that is necessary to give the reader a good idea of the anatomy of the specimen. We desire to say also that, with the exception of possibly two, all of the worms as far as we know are new to science.

It may perhaps be interesting to some to describe briefly the process of preparing these specimens for study. The following technique is generally followed: The worms are first washed in sea water, as fresh water is rapidly absorbed by the body, which becomes swollen and stiff. After the washing they are put under slight pressure and killed in a hot solution of bichloride of mercury, then washed again, after which they are stained with acid carmine, and next passed through several alcohols, and cleared in cedar oil or creosote and xylol, and mounted in balsam. This process for trematodes is one of the most satisfactory plans to bring into view the various anatomical structures, and differentiate them so that they may be seen easily.

It must be borne in mind that all these forms are parasitic, and many of them seriously endanger the welfare of their host, hence in many cases it would be of economic value to study their habits of life and life history. This, however, has generally proved almost impossible, and only in a few cases has it been satisfactorily done, and these have had to serve for the numerous cases by analogy for those in which the life history has had to be guessed at. We know that they are produced from the egg; but how, in the open sea, these microscopical eggs find

their way into the unusual habitats of the host, is largely speculative. It is known, of course, that the egg under favorable circumstances may develop into a free swimming miracidium or ciliated larva which by chance may meet with a fish or other host, when a lodgement may be made, and when it may be developed, for it cannot be developed in any host. The chances are millions against such a thing occurring, so that nature provides such creatures with myriads of eggs on the chance that a few at least will find a favorable host. Of course all this does not apply to those parasites whose eggs are laid and fastened directly on the tissues of the host, where they are hatched.

As is so well known, bacteria and bacilli are the principal parasites in the human diseases which have of late years received much attention from scientists with such good results. These same microscopic parasites attack fish in various ways, and in the future will probably receive the attention they deserve.

I wish here to thank Dr. Townsend, Director of the Aquarium of New York, for his unselfish kindness in forwarding our work in every way. Also the same is due the officials of the Fish Commission at Wood's Hole for their unremitting kindness in furnishing material.

Dasybatus pastinacus (Walbaum, 1793).

STING RAY OR STINGAREE.

It is highly probable that this fish is infested with more parasites than any other known fish. Twenty-seven different forms, not including copepods, are already credited to it and almost any examination of new material develops some new worm.

At Wood's Hole of late seasons, several specimens have been taken of large size from ten to twelve feet in length, including the tail, which is nearly twice the length of the body. These were generally brought to the Laboratory of the United States Fish Commission and examined for parasites, etc. During the last two or three seasons ectoparasites or external parasites have occupied our attention chiefly and it is proposed in the following paper to describe a few of the hitherto undescribed forms which have been met with in examining the sting ray.

Synbothrium lintoni, nov. sp.

(Figs. 1 and 1A)

There does not seem to have been much written upon this cestode, and very few species described.

Diesing seems to have been the first in 1850 to record a worm which he found in a Brazilian fish t. h. *Pristis perottetii* which he called *Syndesmbothrium* in 1854 but which he afterwards renamed *Synbothrium fragile* as the type 1850a. There have been a few au-



Fig. 1



Fig. 1 A

FIG. 1. SYMBOLIC MULTINOMIAL PRODUCTIONS, SYMBOLIC

1. *U. n. n.* 1. N. 1

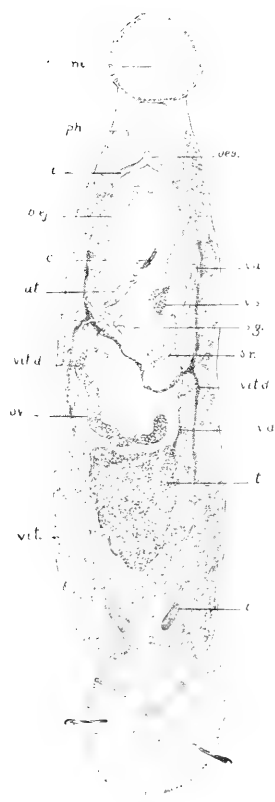


FIG. 2



FIG. 2-A



egg

FIG. 2-B

FIG. 2. MONOCOTYLE DASYBATIS. FIG. 2-A. SIDEVIEW OF *M. DASYBATIS*.

FIG. 2-B. EGG OF *M. DASYBATIS*.

thors since, as Burm. Goldb. Lint. Rail, Scudder, Zsch., etc., who have described its occurrence in a few species of fish, but it does not appear to be a very common parasite, consequently there have been very few species of it named; in fact, *S. fragile*, Diessing 1850 and *S. filicolle* Lint. 1889 seem to be the only ones.

Linton appears to have found *S. filicolle* in a number of fishes, but *S. fragile* in only one instance in 1901. In 1905, however, he came across *Synbothria* sp. in four different species of fish, and these he did not name.

These worms have, I believe, almost always been found in a larval state, encysted in the viscera or peritoneum of the host, so that one cannot always be certain of the species. All of the *Synbothrium* worms which I have found thus far, except *S. lintoni*, have been encysted in the abdomen of the following fishes: *Epinephelus morio*, *Oxyurus chrysurus*, and *Pogonias cromis*, and were of two species, one *S. filicolle* and the other not as yet named. In these cases they were enclosed in an outer cyst which was colored blackish, and within this the true white blastocyst in which the young worm may be seen coiled, so transparent indeed that the hooks might be seen. These cysts are never plentiful as far as my experience goes, at least I have never found more than three or four in the same host, and often only one.

However, on August 1, 1914, while working at the United States Fish Commission Laboratory at Wood's Hole a large sting ray *Dasybatus pastinacus* fell to my share, and, while examining the contents of the spiral valve, I found among the denizens of that interesting structure, four cestodes which were unknown to me. They proved to be adult, and clung to the mucous membrane with their proboscidae. They were with little difficulty freed from their attachment, and proved to be *Synbothria* of a new species. They were quite large, varying in length from 25 mm. to 65 mm. and 2 mm. in width, and some showed ripe proglottides containing eggs. They also showed that other segments had been thrown off, so that really one could not say what the original length of the worm may have been. The head as a whole is quite different in shape from any other *Synbothrium* I have seen, being in the gross much the shape of the head of a Scotch thistle in bloom, set upon a narrow neck, which is followed by a strobila of gradually maturing proglottides.

The bothria are much of the same form as those of other members of the genus. The four bothria occupying the four separate angles and from each of which forming a pedicel as it were a proboscis protrudes form the extreme point. The bothrium in each case lies beside the opening of the proboscis sheath. These prominent portions of the head are exceedingly mobile, being capable apparently of moving in any direction. The proboscides are long and strong, being covered with hooklets which are arranged more or less diagonally around the base or core in several rows, probably ten or twelve. The hooks

appear to be of different shapes and character—each variety is placed in a row by itself which holds throughout the length of the proboscis. One row situated along the inner or concave surface of the proboscis is composed of short strong and much curved hooks and attached to a smooth surface, while the other rows are composed of long slender slightly bent hooks, with the points all directed backwards towards the head and fixed on a surface which is thickly covered with small hooklets or bristles, which give the impression that some of them are young or undeveloped hooks. Under a higher lens power, one can count five rows of the larger hooks to the field, so that there are about ten or twelve rows around the core; they are all composed of semitransparent chitinous material. The bothria and indeed the whole anterior end of the worm under the cuticle is seen to be composed of numerous delicate muscular fibres interlacing in all directions transversely, obliquely and longitudinally, thus giving the head its power of motility. The tubular proboscis sheaths or canals terminate posteriorly in four contractile muscular bulbs which control the protrusion or withdrawal of the proboscidae. The striations in the strobila do not appear at once in the neck, but they show indistinctly to very near the head. The water vascular system is very evident in the form of a canal along each side of the worm throughout its length.

The ripe proglottides are about 2 mm. long and 1.50 mm. wide, and the cloaca, a deep notch with prominent lips, appears on the edge of each segment at the junction of the posterior third with the anterior two-thirds. The cirrus is often seen protruding outside of the anterior edge of the cloaca and it is there so large and bulbous that it seems to block up the outlet of the uterus. The cloaca may appear on the same side of the worm for three or four segments in succession. They are not regularly placed. The eggs are yellow, oval or rounded, not very numerous, and those measured were .040 mm. long by .020 mm. wide.

The segments are largely filled with testes which appear as more or less straight tubes, extending nearly from one end to the other, and parallel to one another. The vas deferens arises from these and terminates in the cirrus. The vitellarium cannot be made out in the material at hand.

Measurements of *Synbothrium lintoni*, nov. sp.

Length	65.00	mm.
Width	2.00	mm.
Head—length	3.40	mm.
Head—width	1.80	mm.
Neck or first segment.....	.60	mm.
Proglottid—length	2.00	mm.
Proglottid—width	1.50	mm.
Eggs—length04	mm.
Eggs—width02	mm.

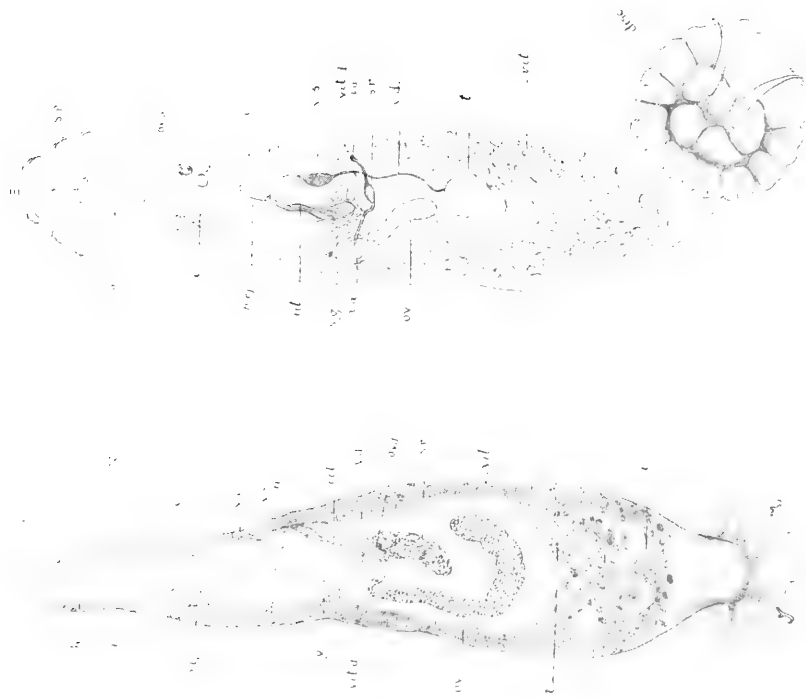


Fig. 3

FIG. 3. MONOCOTYLE DASYBATHIS MINIMUS.

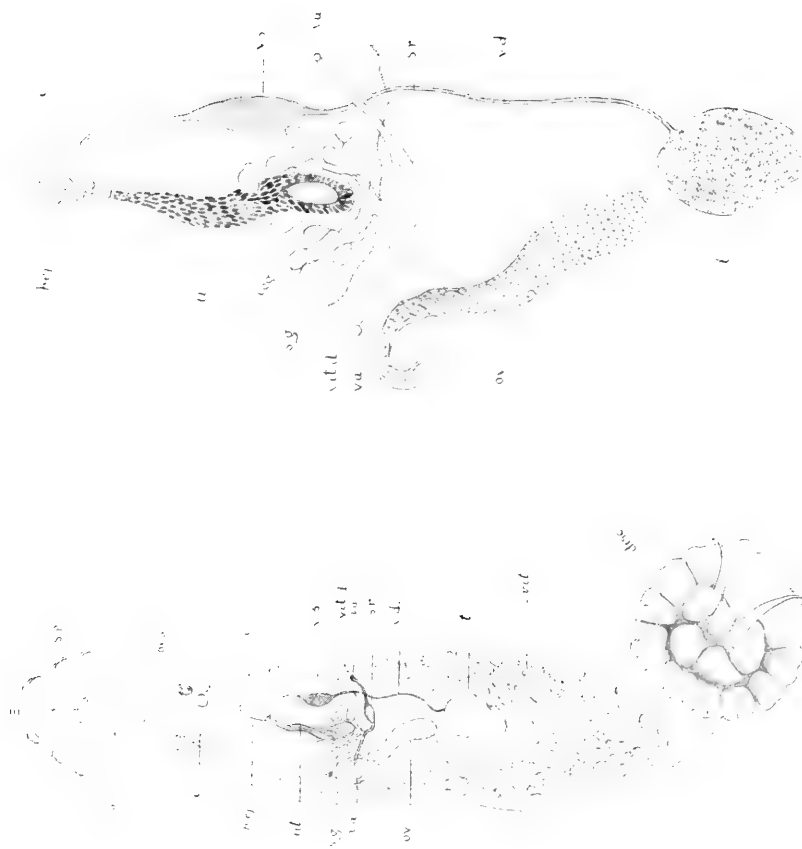


Fig. 4

FIG. 4. MERIZOCOTYLE DASYBATHIS.

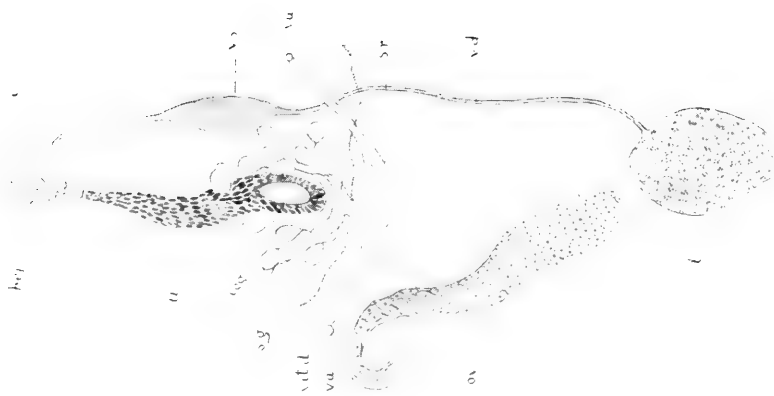


Fig. 4-A

FIG. 4-A. GENITAL SCHEME OF *M. DASYBATHIS*.

Monocotyle dasybatis, nov. sp.

(Figs. 2 and 2A and B)

Order Trematoda (Rud.).

Sub-order Heterocotylea (Mont.).

Family Monocotylidae (Tasch.).

On July 17, 1915, five of the above worms were found in the gills of a large female sting ray which measured seven feet nine inches in length by three feet three inches in width. The worms measured seven to eight mm. in length by 1.80 mm. in width and were found in the profuse thick mucus which makes an examination of the gills of this fish difficult. It is true that the worm found in the gills of *Myliobatis aquila* Dumeril, one of the eagle rays in European waters and named by Taschenberg *Monocotyle myliobatis* in 1878, is somewhat like the form found in the gills of *Dasybatus pastinacus*, common sting ray, for which I propose the name *Monocotyle dasybatis*, yet as far as can be made out by the description and the rather imperfect portrayal of the anatomy there are fundamental differences which make it necessary to claim for *Monocotyle dasybatis* the right to be called a new species. This latter is nearly twice as large and the mouth, sucker disc and cirrus are different. *Monocotyle ijimae* is also different since it has three testes and a very different cirrus. The head of *M. dasybatis* is 1 mm. in diameter and is composed of one large terminal sucker, trumpet shaped and facing ventrally. Near where it terminates in the pharynx there are three lobulated portions, one on each side, larger than the median one; however, they all concentrate in the pharynx and the whole structure is smooth and unarmed except that along the external margin is a narrow row or rim of muscular cells and minute tubes which may assist in the power of suction or in maintaining its position when functioning. The whole head is cordate in shape with the extreme anterior end cut more or less square. The whole structure shows many muscular fibres running through its walls in many directions and these no doubt control the functions and movements of this ample mouth.

The pharynx is large and receives directly the small end of the bell-shaped anterior sucker. It is oval in shape with a median ridge or line running longitudinally from before backward and on each side are eight or nine transverse ridges, giving it the appearance of muscular strength. The postpharyngeal oesophagus is short and divides as usual into two ceca which pass along the sides of the worm posteriorly as far almost as the anterior margin of the sucker disc.

The genital pore is placed near the division of the ceca in the angle formed thereby. It is large and oval and has a patch of spicules on its anterior and posterior edge.

The testis is large, roughly triangular and somewhat lobulated with its base directed anteriorly from near the centre of which the vas deferens arises and proceeds in a winding course toward the gen-

ital pore where it terminates in an armed cirrus which overhangs the genital pore. At about two-thirds of the length of the vas from its origin it widens into a large vesicula seminalis. It then narrows again until near the genital pore where it passes into and through an oblong bulbus ejaculatorius terminating in an armed penis, which organ is comparatively large and thick. It is curved and has a cluster of spicules at its tip.

The ovary is a more or less horseshoe-shaped tubular structure with the concavity directed forwards and is placed immediately in front of or anterior to the testis. In the concavity formed by the curvature there is situated the genital junction which is about at the middle of the worm. The opening of the vagina is seen about opposite the genital pore in the left vitellarium, and the vagina itself plainly showing its circular muscular fibres, runs in a crooked course to terminate in the base of the seminal reservoir which is a large muscular sac. Its tube joins the oviduct prior to the junction of the vitelline duct. The shell gland is distinct and consists of a number of somewhat large masses connected with tubes of varying length to the ootype. The portion of the uterus following the ootype is wide and its walls are composed of long muscular cells giving through its outer coat a spiny appearance.

The uterus is not long but is relatively wide and terminates near the genital pore in a vase-shaped structure, and the mouth is armed with spicules.

The worm as a whole is elongated and appears to be of a very delicate structure and even when alive is more or less transparent, so much so that the principal organs may be seen and traced pretty plainly. Fig. 2a gives a lateral view of the body form.

The sucker disc is a saucer-shaped structure, concavity ventral. It is 1.80 mm. in diameter and is attached to the body on its dorsal surface at about its center with little or no pedicle. It has two fairly large hooks on its anterior surface, one on each side which extend out to and a little beyond its margin almost transversely. There are eight rough ridges and eight loculi shown on its dorsal surface, two of the latter are much larger than the others, the ridges being chitinous and irregularly striated transversely. The two hooks are each laid in close connection with one of these ridges so as to give them firmness of attachment. The dorsal surface of the disc between the ridges is thickly covered with small irregularly-shaped plaques, somewhat like squamous epithelium. The disc as a whole has a definite margin, but extending beyond this is a delicate narrow rim of mucous membrane, and in or on this membrane are delicate, cone-shaped bodies or tubes which are placed regularly side by side around the whole structure, but not extending quite to the extreme outer margin. These cone-shaped portions are crossed by numerous delicate transverse markings or striae. Again immediately within the bases of these cones is

another rim of what appears to be a narrow band of muscular tissue about half the width of the band of cones and the fibres of which are directed regularly in parallel lines toward the bases of the cones, and they doubtless control the movement of the cones as a whole or in part. Other than the transverse ridges on their surface the cones appear to contain a fine granular matter. A somewhat similar structure surrounds the mouth or anterior trumpet-shaped end, although the divisions are not so pointed, and they rather give the impression that they function as sensory areas, although each is composed of three or four deeply stained cells which have fine ducts or lines running towards the centre of the structure or throat, possibly for the secretion of mucus.

The vitellarium is profuse and very beautifully arranged in golden colored masses. A bluntly triangular, shrunken, yellow egg is seen, and in connection with one angle a chitinous filament attached to it does not seem long. The egg is situated at the genital opening.

For the purposes of classification it may be said to be elongate, head cordate in shape with a large trumpet-shaped unarmed mouth, with narrow margin or rim of cells, no large sensory areas, sucker disc with eight ridges, two large hooks, eight loculi, and ornamented with a rim or margin of muscular tubules. Found on the gills of *Dasybatus pastinacus*.

Measurements of *Monocotyle dasybatis*.

Length	7 to 8.00 mm.
Width	1.70 mm.
Width of head	1 to 1.20 mm.
Diameter of sucker disc	1.65 to 1.80 mm.
Length of testis80 mm.
Width of testis20 mm.
Egg length06 mm.
Egg width05 mm.

Monocotyle dasybatis minimus, nov. sp.

(Fig. 3)

Order *Trematoda* (Rud.).

Sub-order *Heterocotylea* (Mont.).

Family *Monocotylidae* (Tasch.).

On July 17th, 1915, there were found twenty or twenty-five specimens of a small worm on the gills of a large sting ray which it is thought has not hitherto been described. It measures 1.60 mm. in length by 0.37 mm. in width and in situ is invisible to the naked eye.

It is elongated and somewhat triangular in shape, being much wider posteriorly than at the mouth. It is very convex dorsally and correspondingly concave ventrally, although in life quite capable of extension so that the above mentioned shape does not hold except in quietude. It is provided posteriorly with a relatively large sucker disc which is circular and quite as wide in diameter as the widest part of the body. The disc is divided into eight irregularly rounded loculi by eight rough ridges. The posterior end of the body of the worm is implanted on the dorsal surface of the disc at its middle without any pedicle. There are two fairly large much curved hooks on the anterior or ventral surface of the disc. It is also supplied with a number of minute hooks, eight on its margin, which appears to be reinforced by a narrow muscular rim to which the small hooks are attached. The whole skeletal part of the disc appears to be rough and of a chitinous character. The two larger hooks are attached each to one of the strong rough ridges which gives greater power of support. The whole disc is connected to the body of the worm by rather long muscular bands through which it is completely under control, holding the body firmly in place during the performance of its life functions. Its dorsal surface is quite ornamental.

The mouth is subterminal, circular and surrounded by thickened lips, one portion too appears to be more protrusible than the rest. It is very like that in a distom and no doubt acts as a sucker when required to do so. The prepharyngeal oesophagus is short and muscular, terminating in a relatively large and muscular pharynx which is distinctly marked by transverse ridges on each side of its surface. The postpharyngeal oesophagus is also short and, as usual, divides into two ceca which run backwards along the sides almost to the sucker disc. Anteriorly in the angle formed by the division is the genital pore which is generally overhung by the male genital apparatus, the ejaculatory duct, cirrus, etc. Nearby is generally seen a collapsed egg which then appears to be triangular (Fig. 3), and is provided with a filament attached to the posterior pole. It is yellow and chitinous and always single.

The single testis is situated just behind the ovary in the centre of the body—a relatively large vas deferens runs in an irregular course anteriorly, winding around the bulbus ejaculatorius, finally entering the posterior end of that organ and passing through it, terminates in a long curved chitinous cirrus which expands into a trumpet-shaped point at its end. The ovary is a tubular shaped organ placed far back across the body and just in front of the testis. Its concavity looks forward or anteriorly and in the space one of the most conspicuous organs is seen, a large seminal reservoir, very muscular, and supplied from a vagina whose inlet is situated on a small papilla on the right side nearly opposite the mouth of the uterus and terminates in the seminal reservoir with which it is connected at its base. The vitellaria are very

plentiful and extend to the extreme end of the body on both sides from opposite the pharynx anteriorly.

The genital junction is situated at about the middle of the worm and is quite distinct; the vitelline ducts arising at about the junction of the anterior third with the posterior two-thirds of the body proceed backward and internally until they meet the oviduct directly in front of the seminal reservoir which sends its tube to the oviduct at this point and almost directly after this the ootype appears surrounded by the shell gland. The uterus is rather short and terminates in the genital pore on its right side when the worm is viewed dorsally.

Measurements of *Monocotyle dasybatis minimus*.

Length	1.60 mm.
Width40 mm.
Diameter of disc40 mm.
Egg	0.06 mm. + 0.05

For classification it may be said to be elongate, wide at the base or disc and narrow at the apex or mouth. Mouth surrounded by a thick roll or lip, one side of which is prolonged to a point. Disc composed of eight loculi and eight ridges—two large and eight small hooks, and the whole dorsal surface of disc ornamented with roughened striae of chitin.

Merizocotyle dasybatis, nov. sp.

(Figs. 4 and 4A)

Order Trematoda (Rud.).

Sub-order Heterocotylea (Mont.).

Family Monocotylidae (Tasch.).

Genus *Merizocotyle* (Cerf.).

On August 1, 1914, while examining a very large sting ray *Dasybatis pastinacus*, at the United States Fish Commission's Laboratory at Wood's Hole, Mass., I found in the nasal mucus glands a number of odd forms. They were embedded in the profuse thick mucus which is always present in or near these glands. Many were found deep in between the laminae of the gland and in some cases were rather difficult to detach.

It has been customary for former writers to state that these trematodes as well as many of the acanthocotylidae have their habitat on the skin and gills of their hosts, but I am sure from the numbers of them that I have seen in the nasal glands of rays, skates, etc., that their natural and permanent habitat is there and that the other locations are merely accidental.

This form has been placed in the family Monocotylidae, Tasch., and the genus *Merizocotyle* (Cerf.). Of the few who have observed this worm Cerfontaine has written the best description which is available to me. His description of *M. diaphanum* and *M. minus* seems quite complete and enables me to know that the species herein described is not either of these, as will be seen from the following description:

The worm for which I propose the name *M. dasybatis* is 2.40 mm. in length by .60 mm. in width. It possesses a large almost circular concavo convex sucker disc as wide or nearly as wide as any part of the body. The body is elongated, concave from end to end and from side to side ventrally and convex dorsally, and is somewhat constricted anterior to the sucker and at the neck. The head is triangular in shape and divided by a deep notch which extends posteriorly from the tip nearly to the pharynx. On each side of the notch on the ventral surface are three quite large tactile areas or papillae and running backwards from each of these is seen a wide duct disappearing under the vitellaria.

The mouth is a peculiar protrusible tube at the anterior opening of the pharynx and forming when quiescent merely a thickened rim of circular folds. It conveys the impression of being capable of considerable extension and of suctorial power. The pharynx is goblet-shaped and large; it is surrounded by a large number of unicellular glands in masses distributed posteriorly almost as far as the genital pore. On the dorsal surface over the pharynx are four ocular spots.

The intestines seem wide and are given off behind the pharynx without any great prolongation of oesophagus and at their bifurcation the genital opening appears surmounted by the chitinous cirrus.

The male genital apparatus.—The testis is single, pear-shaped and large, but not so disproportionately large as in *M. diaphanus* and *minus*. It is situated at the junction of the posterior third with the anterior two-thirds of the body encroaching upon each division. The vas deferens passes anteriorly along the left side until nearly opposite the middle of the short uterus and then expands into a large vesicula seminalis; from this it passes forward to the base of and through the bulbus ejaculatorius a round muscular organ at the base of the cirrus which surrounds the vas deferens in this portion of its course.

The cirrus is a curved hollow chitinous tube slightly turned up at the tip. In the bulbus ejaculatorius beside the vas deferens passing through it may be seen at its base and on each side a small gland which sends a tube forward toward the base of the penis.

The female genitalia consists of a twisted horn or flask-shaped organ (the ovary) with a long neck, which, after coiling upon itself once, proceeds forward to the genital junction about the middle of the worm, after which the oviduct widens into a wide ootype, and this in turn merges into the uterus.

The ootype is an unusually wide, thick portion of the genital canal and is lined with a layer of large, elongated, deeply-staining cells. In this instance it contains an almost completely developed egg which seems relatively large; it is yellow, oval and with a moderately long filament at each pole.

The uterus is short and muscular and terminates in a thick-lipped flaring mouth at the edge of the genital opening, situated centrally near the cirrus and bulbus ejaculatorius.

There are two vaginae opening ventrally, one on each side near the margin of the body. They join in the middle of the body in the form of a hammock, the central portion being the seminal reservoir. Towards the outlet of each vagina its walls contain circular muscular fibres which act as a constrictor. This whole structure is slung across the body at the posterior end of the ootype and very near the genital junction.

The shell glands are large and with long necks, but not excessively numerous.

The vitellaria are plentiful and extend from the base of the pharynx almost to the disc posteriorly. It covers the intestinal ceca from view until near the disc.

The disc, or sucker, is large and powerful and is composed of several suckers and hooks.

It is nearly circular and concavo convex structure, the ventral surface presenting five central loculi, one small deep one in the centre and four larger ones surrounding it. On the margin there are twelve suckers beside the large triangular space at the extreme posterior, formed by the divergence of the very large pair of hooks situated here. This space appears to have four small suckers near its margin, and there are also here four small hooks, one for each sucker. There are two long straight spicules here which run to the two middle small hooks. Each sucker around the rest of the margin of the disc is supplied with a small hook.

Measurements of *Merizocotyle dasybatis*.

Length	2.40 mm.
Width60 mm.
Disc, diameter30 mm.
Hooks on disc, length17 mm.
Testis11 x .08 mm.
Ovary to beginning of genital connection	.35 mm.
Egg04 x .03 mm.
Cirrus, length05 mm.
Pharynx07 x .05 mm.

Trionchus dasybatis, nov. gen. et nov. sp.

(Fig. 5)

Order *Trematoda* (Rud.).

Sub-order *Heterocotylea* (Mont.).

Genera *Monocotyle* (Tasch.).

This worm was found on the gills of a very large sting ray *Dasybatus pastinacus*, on August 1, 1914, at Wood's Hole, Mass., and was studied at the Laboratory of the United States Fish Commission there.

Only two specimens were found, as the gills were very large and thickly covered with mucus, so that the worms on account of their small size (1 mm. x .60 mm.) were easily overlooked. Besides, their attachment is exceedingly firm, so that few were brushed off. When first seen they were very active, alternately shutting up their discs toward their heads and again relaxing them. When closed they reminded one of a trilobite. The body is plump, very concave in all directions ventrally and very convex dorsally.

For the purpose of classification the following characters may be given: The mouth large and subterminal, much like an ordinary sucker; genital pore central; cirrus chitinous; single testicle posterior to ovary; a relatively large sucker disc with one large loculus in the centre and three small marginal ones. There are also on the disc three hooks, one large one terminating in two points and also two smaller ones.

The mouth is large and circular occupying almost the whole width of the anterior end. The lips are thick and could act in the capacity of a sucker when necessary.

The pharynx is very near the mouth, a muscular barrel-shaped structure divided into two halves on the surface by a central antero-posterior line or groove, and each half shows transverse lines which apparently divide it into seven bands of muscular tissue.

The vitellaria reach on each side to about the middle of the pharynx and extends posteriorly along each side of the disc for a short distance.

Immediately posterior to the pharynx and surrounding to a great extent the short post pharyngeal oesophagus and its bifurcation into the intestinal ceca, is a mass of unicellular glands which supply these structures with mucus. The intestinal ceca extend to near the junction of the middle with the posterior third of the body.

The male genitalia are quite distinct. The testis is situated in the posterior portion of the body just behind the ovary; it is fairly large and somewhat pyriform in shape and from the small anterior end there arises the vas deferens; this empties into the flask-shaped vesicula seminalis. The vas deferens continues as a narrow tube for some distance, when it widens again into a fusiform enlargement the ductus ejaculatorius and from the anterior

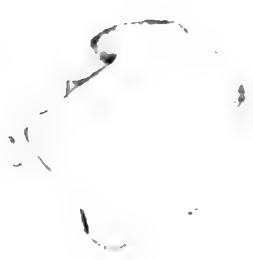
FIG. 2. *IRONITE'S DISSEMINATION*



FIG. 3. *MONOCRYSTALLINITY*



FIG. 4. *ANTHRACITE VIEW OF MONOCRYSTALLINITY*





end of this it extends to the base of and through the bulbus ejaculatorius to terminate in the cirrus. The bulbus ejaculatorius is a more or less round muscular ball or sac, the name of which indicates its function.

The cirrus is a slightly curved, relatively long, yellow chitinous tube, the base of which is applied to the bulbus ejaculatorius by means of three spreading arms or branches of chitinous material covered in with muscular tissue, etc. The tip end terminates in two or three spiny processes.

The ovary is large and somewhat semilunar in shape with the concavity looking anteriorly and one end is prolonged into an oviduct. Only the mouth and terminal portion of the uterus is apparent in these crushed specimens. The mouth is funnel shaped. The widened mouth in this case contains a fully formed egg, and is situated near the margin of a genital atrium placed well within the angle formed by the bifurcation of the intestinal ceca and is therefore central.

The egg is irregularly oval, yellow, and has a filament attached to its anterior pole. This filament is rather less in length than the egg itself, which measures .045 mm.

The sucker disc on its ventral surface is concave and oval in contour. It is seen to be divided into one large deep sucker occupying most of the disc and three small marginal ones. In the centre of the margin the largest of these smaller suckers supports through its centre the largest of the three hooks, and extending out from it is a tongue-like process of skin which also helps to support the central large hook. These are the only hooks on the disc. The large one is three times as large as the lateral ones, which are more curved than the large one. The large hook is .07 mm. long and terminates in two sharp hooklets. The marginal skin is extended outward opposite each of the other loculi, but not to the same extent as in the case of the central one.

In life the sucker disc is frequently clasped to the front end of the body and by this movement the progression of the worm is in some way facilitated; it may be much as a crab or lobster flaps its tail.

In the narrow portion between the body and the disc many muscular fibres are seen extending up into the body. Excretory canals can also be seen, but no outlet could be made out.

Measurements of *Trionchus dasybatis*.

Length	1.00 mm.
Width60 mm.
Sucker disc, width25 mm.
Sucker disc, length14 mm.

Long hook on disc, length070 mm.
Short hooks on disc, length025 mm.
Cirrus, length040 mm.
Egg, length045 mm.
Egg, width035 mm.

Monocotyle selachii, nov. sp.

(Figs. 6 and 6A)

Order *Trematoda* (Rud.).

Sub-order *Heterocotylea* (Grout.).

Family *Monocotylidae* (Tasch.).

On July 19, 1915, at the Laboratory of the United States Fish Commission, Wood's Hole, while examining the nasal glands of a large *Cestracion zygaena* there was found within them a *Monocotyle* which is regarded as a new species.

It is elongated in form and almost of equal width throughout including the head and disc. The head is of an irregular square shape with four prominent enlargements, two on each side of a concavity at the anterior margin which does not, however, denote the location of the mouth. The enlargements are evidently sensory areas and probably are capable of some extension when the worm is feeling its way about. However, there does not appear to be any suckorial arrangement by which the worm is enabled to maintain its position, if we leave out the mouth at the anterior portion of the pharynx. Almost in the centre of the portion called the head is seen a more or less square shaped structure which represents the pharynx with the mouth in front. The mouth and perhaps part of the pharynx is protrusible as needed. This is shown by the thickened and movable lips. The mass also includes the origin of the ceca which start from the posterior lower part of the pharynx and pass almost at once behind the vitellaria, which hide their course backwards. A very short distance further posteriorly a coil of the vas deferens appears before it makes its way to enter the rounded end of the bulbus ejaculatorius which in this instance is directed toward the pharynx and is oblong and large relatively. From its other end projects the cirrus which is rather short and wrinkled and somewhat triangular, point blunt and quite rounded. It is covered with an outer shell, and is probably protrusible. The whole structure in this instance lies anterior to and over the genital pore.

The vas deferens passes anteriorly along the right side, and shows it to be full of spermatozoa.

The testis is either enclosed in a sac and lobulated, or it consists of several small masses or testes. The posterior end of the worm is so filled with vitellaria that a clear view of this organ is impossible—an examination of further and better material may clear up this point.

The ovary is situated near the middle of the body, and is somewhat S-shaped. One end, however, is thick and massive, while the anterior portion is prolonged into a long narrow coiling neck, which in one instance at least, reached nearly to the genital pore. This, however, seemed to be exceptional, since the oviduct arises generally from the anterior portion of the organ and almost at once receives the vitelline ducts. No seminal reservoir could be made out in the material examined, nor could a vagina be traced, although an opening could be seen on the right side of the genital pore, very near the vitellarium, which seemed to be the mouth of a vagina. The vitellaria are plentiful and extend from the pharynx to the caudal disc, being unusually profuse posteriorly.

The sucker disc is a large structure of unusual formation. It is armed with two short strong and much curved hooks on the anterior surface, and in the worms from the *Carcharias obscurus* there are also a number of very small hooks on the extreme margin, but so far no small hooks could be seen on the edge of the disc in the case of those found on *Cestracion zygaena*, although otherwise the worms seemed alike. The ventral surface of the disc has scattered over it a great number of small circular loculi or suckers of different sizes, and which probably have different or separate innervation which may enable the worm to have greater power, or to release its hold partially at will; be that as it may, the fact is that this disc has only two large hooks besides, along the margin, several small ones placed at regular intervals. There are no ridges, and the worm must depend on its large sucker for support in its place of attachment, assisted by the powerful pharynx and mouth, where there appears much muscular tissue. It is probable though that as the nasal gland is its local habitat enclosed from outside influences and fixed in profuse sticky mucus, it does not need any greater means of adhesion. Some writers have described the findings of worms of this class on the skin and in the mouth of their host, but it must be that they are only accidentally in these situations, their proper home is in the much protected nasal gland.

For the purpose of recognition and classification it may be said to be oblong, even in width throughout, sucker disc with two hooks, several very small ones on the margin and no ridges, the ventral surface covered with numbers of small suckers of different sizes, body very delicate and fragile. Found in the nasal gland of *Cestracion zygaena* and other sharks and no where else so far; genital pore central. The skin is unarmed and the body is sparsely covered throughout with small cells, muscular tissue thinly distributed except at the junction of the disc and the body, water vascular system quite evident, on each side of the pharynx are to be seen small ducts which develop into quite large canals which show as an open line on each side in the dense vitellaria. They terminate near the disc, but no definite outlet is seen. Since the same worm is also found in the

nasal passages of *Carcharias obscurus* as well as *Cestracion zygaena*, and, as I have no doubt it may be also found in similar locations in other sharks, I would therefore propose the name *Monocotyle selachii*.

Measurements of *Monocotyle selachii*.

Length	5.40 mm.
Width	1.00 mm.
Width of head	1.20 mm.
Width of disc	1.00 mm.
Length of disc hooks	0.03 mm.

Diplectanum plurovitellum, nov. sp.

(Fig. 7)

Sub-family *Gyrodactylidae* v. Ben. et Hesse

Genus *Tetraonchus* v. Ben. et Hesse

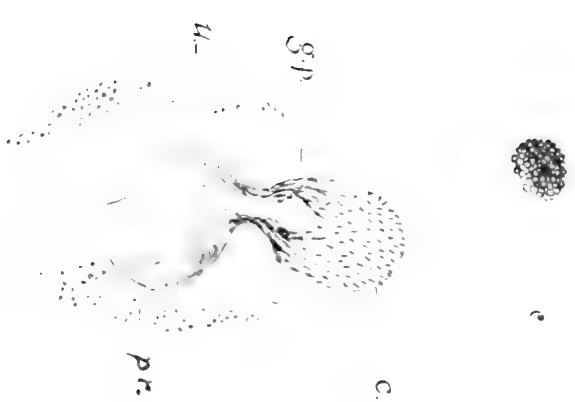
Sub-genus *Diplectanum* v. Ben. et Hesse

A new form of *Diplectanum* was found on the gills of *Teuthis hepatus* on November 27, 1915, which seems to have escaped observation hitherto. It has also since been found on the gills of *Anisotremus virginicus*.

Like all the other members of the family it is small, being only 1.60 mm. in length by .20 mm. in width. Its head is more or less conical in shape, much more so than any of the other known members of the family, but the most striking feature of its anatomy is the peculiar arrangement of the vitellaria which is distinctively blocked, cut into two rows, one on each side of irregular more or less triangular blocks distinctly separated from one another, except that along the internal margin of each row, where they are connected by an antero-posterior column of vitellarium. There are generally sixteen or seventeen of these portions on each side, and they extend from nearly as far forward as the pharynx and to near the disc posteriorly. The mouth is not definite but the pharynx is large and prominent and probably serves as the mouth. On each side of this extending from about its middle on each side is a row of tactile areas which seem to serve as sensory areas. They extend nearly to the extreme anterior end of the worm. There are four ocular spots, two just within the edge of the pharynx and two more anteriorly. The bifurcation of the oesophagus takes place back of the pharynx, and is not very distinct, although it can be made out to a certain extent in the usual situation and a short distance posterior to this division may be seen the genital pore, where the uterus terminates.

The uterus is short and evidently only contains one egg at a time for in each specimen under observation the uterus contains an ovoid, yellow egg which is relatively large; it is without the

FIG. 2. *DIFFUSION OF HYDROPHILIC POLYMERS* FIG. 3. *DIFFUSION OF HYDROPHILIC POLYMERS* FIG. 4. *DIFFUSION OF HYDROPHILIC POLYMERS*



usual filament. Over the genital pore the cirrus presents itself and is peculiar in form being in this quite as diagnostic as those of the other species. It is long and curved and has a bulbus ejaculatorius at its posterior end which is more or less pear-shaped, the larger end being posterior. The ovary is roundish or rather ovoid and is centrally situated at the junction of the anterior quarter with the posterior three-quarters of the worm, and immediately behind it is the large single roundish testis. The genital junction is directly in front of the ovary. The vas deferens passes on the left side of the ovary towards the posterior end of the bulbus ejaculatorius.

The intestines or ceca seem to join into a single tube posterior to the testis which passes down the middle to nearly the posterior end of the worm.

The disc is directly terminal after the body has narrowed somewhat. It is armed with two large and strong hooks which point laterally and at least also with eight spicules or small hooks on the posterior edge of the end of the disc. The skin is smooth and unarmcd.

On the gills of the same host were a number of *Diplectanum teuthis*.

Measurements of *Diplectanum plurovittellum*.

Length	1.60 mm.
Width	0.20 mm.
Egg05+.02 mm.

Acanthodiscus remorae, nov. sp.

(Figs. 8 and 8A)

Order Trematoda (Rud.).

Sub-order Heterocotylea (Mont.).

Family Gyrodactylidae v. Ben. et Hesse.

On May 16, 1915, while examining some material from New York Aquarium I found on the gills of an *Echeneis naucrates* a small worm as well as a lot of specimens of *Dionchus* (Goto). Again on May 19, more attention was paid to the gills of a larger fish, which in order to secure more specimens of the new worm, the gills were rubbed under water between the fingers and thumb, and the result proved to be the dislodgement of a number of the worms sought although a good many had left their discs adhering to the gills. Several, however, were perfect and answered the following description: It is small, not more than 1.80 mm. long and .30 mm. wide. It is elongated and presents as its chief characteristic a relatively large posterior clinging disc on which are two large much curved hooks. These seem to be attached to a loose marginal fold around the edge of the disc. The disc is concave and presents on its sur-

face a series of irregular depressions, but no ridges may be seen. It merely looks like one large sucker with near its center two large hooks, one on each side, much curved and with the points looking toward the center of the disc. The skin is thick and unarmed, although it is serrated. The head of the worm is in shape that of an obtuse triangle with the small mouth terminal; a short distance from the mouth is seen the pharynx and between the two are four ocular spots. Around the ocular spots and also enclosing part of the pharynx is a circle of deeply stained mucus cells three or four deep. The head is somewhat marked off from the body by a notch on each side conveying the impression of the presence of a neck and it is surrounded by a margin of elongated mucus unicellular glands so closely set together, and staining more deeply than the neighboring tissue that it gives the appearance of a narrow band extending as far as the neck a little back from the edge of the worm. Inside of this band of cells is a narrow, clear space, where the water vascular ducts are plainly seen also surrounding the head.

The pharynx is roundish, and it is surrounded by a circle of mucus cells which apparently supply it with mucus. On the left side of the neck the genital atrium is placed, a short distance from the edge. It is sparingly armed with a cluster of spicules. This opening is almost directly opposite the pharynx, and shows the cirrus and uterus there. There are two testes, one before the other in the center of the body, and either one is twice as long as the ovary, which is situated in front of them. They are oblong and rounded and give forth a relatively very large vas deferens which is much coiled and makes its way anteriorly, first emptying into a large vesicula seminalis then into a large cirrus sac. The cirrus itself is apparently armed at the end, and is more or less globular at this point with a large prostate behind. The ovary is small and round and situated about the middle of the worm. The oviduct is fairly long, and is met by a duct from the seminal reservoir situated on the left side and in front of the ovary; but if there is a vagina it must be back from the margin of the worm among the vitellaria, for it cannot be made out distinctly. The ootype is surrounded by a voluminous shell gland, and the uterus near its termination is provided with a metraterm well developed. The intestines are not easily followed in their course under the profuse vitellaria which extends from the neck on each side to near the disc posteriorly. No fully developed eggs were seen.

Measurements of *Acanthodiscus remorae*.

Length	1.80 mm.
Width30 mm.
Diameter of disc40 mm.
Width of neck at eyes20 mm.
Diameter of ovary10 mm.
Diameter of testis20 mm.



Fig. 9



Fig. 9-A



Fig. 9-B

FIG. 9. — *R. INTHOCOTYLE RH*. FIG. 9-A. LATERAL VIEW. FIG. 9-B. NASAL GLAND.

Acanthocotyle raiac, nov. sp.

(Figs. 9 and 9A and B)

Sub-order *Heterocotylea* (Mont.).Family *Gyrodactylidae* v. Ben. et Hesse.

On July 4, 1914, while examining a large summer skate, *Raja erinacca* at the Laboratory of the United States Fish Commission at Wood's Hole, there were found in the nasal mucus sacs or glands a number of small forms for which I propose the above name.

The nasal gland of fishes seems to have received scant attention and the fact that it is a very favorite home for certain species of Heterocotyleans and even some crustaceans as Copepods, Ergasilles, etc., seems to have been entirely overlooked. The wide open nostrils of course are always noticed, but behind these are the large mucus glands whose function seems to be to secrete large quantities of mucus, perhaps to assist the numerous skin glands in the anterior portions of the fish to lubricate the front and thus facilitate speed, lessen friction, etc. In *Raja erinacca* the gland is a little over two inches long by a little over an inch wide and is more or less cylindrical. It is open at one side and closed by a broad, band-like structure on the opposite side which runs from end to end. Each side is composed of many thin lamellae placed closely side by side across the length of the structure which allows it to be opened like a book although the leaves run in an opposite direction. It is generally filled with thick mucus and in this the worms live. (Fig. 9b.)

To show that the location where found is the natural habitat, I may say that in this instance as many as twenty-five worms were found in the two glands. They were also found in the same location in other skates of this species, as well as in *Raja ocellata*. It has been customary with parasitologists to credit this family of small worms as skin parasites, and indeed they may sometimes be found on the skin, but I am confident that their position there is merely accidental, for as may be seen by the description of its anatomy it could not derive any nourishment on the outer skin of these large and rough fishes, nor could it even retain its hold there for any prolonged time; while embedded always in the plentiful mucus of the nasal glands, they not only find plenty of nourishment, but are protected from outside exposure.

The present member of the group is only 1.60 mm. in length by 0.60 mm. in width. It is elongated in form, delicate in structure and of nearly equal width throughout. It is concave ventrally and very convex dorsally. (Fig. 9a.) Its most prominent feature is a large roundish sucker disc at its posterior extremity. Its head or anterior end is but little curved from side to side, and in the centre is a shallow notch, on each side of which are three sensory papillae. A short distance posterior to the notch in the anterior

border is a prominent pharynx, the anterior end of which has thickened lips which constitute the mouth of the worm.

The oesophagus is short and divides into two wide intestinal ceca which extend well back towards the disc. The disc is round and concavo-convex having on its ventral surface fourteen suckers of medium size around the margin and five larger ones in the center. These are separated by prominent rough ridges, indeed every loculus is surrounded by a very rough margin. At or near the outer edge of the space between each pair of marginal suckers is a very small hook. The disc is almost as wide as any part of the body being 0.39 mm. in diameter.

The male genitalia consist of two relatively large oblong testes which lie side by side in the middle of the body and immediately behind the ovary. The vasa deferentia unite and run coiling forward to form a prolonged widened portion or sac,—the vesicula seminalis. This sac shortly narrows to a small tube which again widens into a fusiform structure, the ductus ejaculatorius, which in turn narrows and enters the base of the bulbus ejaculatorius; passing through this organ it terminates in the cirrus a long curved organ which flares somewhat at its extremity. It is chitinous in structure and somewhat yellow in color, it overhangs the genital pore and is apparently always directed backwards.

The female genitalia consists of an irregularly curved flask-shaped body, the ovary with a long neck. Its base rests between the anterior ends of the testes and the neck extends forward toward the genital pore coiling somewhat on its way. The genital pore is situated centrally in the angle formed by the beginning of the ceca. The neck of the ovary ends in the oviduct which shortly receives the vitelline ducts projecting from the vitellaria on the sides. The seminal reservoir lies across the worm a short distance posterior to the uterus. It is in the shape of a hammock having a vagina connected with it on each side. It communicates here with the oviduct which passes on to pass through a large shell gland and then merges into a peculiarly shaped uterus which is somewhat fusiform or pear-shaped, the widest portion being anterior and displaying there its mouth with very thick lips. The uterus seems to be constructed of large muscular cells which stain deeply. It seems only constructed to hold one egg at a time and in one specimen an egg was seen to occupy the mouth. This was oval, somewhat collapsed, yellow and with a short chitinous filament attached to one pole. The egg measures 0.02 mm. (Fig. 9.) The vitellaria are very plentiful, extending along to the sides from opposite the pharynx to near the disc.

For the purpose of classification the worm may be said to be elongated, to three times its width, although this varies much in life, disc without large hooks, but with fourteen marginal loculi,

FIG. 10. *INTHOLOMYIA MERITCHI* IMMERJANS

b. One of the large suckers or claspers. d. Hooks at tip of disc.

five internal ones, and several small hooks. Occurs in the nasal glands of several species of skates.

Measurements of *Acanthocotyle raiac*.

Length	1.60 mm.
Width50 mm.
Diameter of disc30 mm.
Egg02 mm.

Anthocotyle merlucii americanus, nov. sp.

(Figs. 10 and 10A)

Family *Octocotylidae* v. Beneden et Hesse.

At Wood's Hole, Mass., at the Laboratory of the United States Fish Commission on August 1, 1913, I found on the gills of *Merlucius bilinearis* a worm which in general appearance resembles the *Anthocotyle merlus*, or *merlucii*, first described by Van Beneden and shown by a plate given in his paper and also by Dr. M. Braun. This plate, however, shows no anatomy of the worm except in the most general outline. On studying the present form more closely I found that while of the same genus it was not by any means the same worm or the same species. In the first place this is larger and the first two large suckers which are such a prominent feature in the form are not at all like those of *A. merlucii* of the European hake either in their shape or structure. Again, while *A. merlucii* has only the eight suckers usual with the Octocotylinae the new worm has beside these a small square shaped extension of skin between the posterior pair of suckers on which are placed four small hooks and which form the extreme posterior limit of the worm. These differences have induced me to ask a place for the American form as a new species.

The worm is found in sparse numbers only as far as I know on the gills of a common well known fish on the New England coast,—the New England hake, or whiting, *Merlucius bilinearis*. This fish is common in American waters from the Bahamas northward to the Straits of Belle Isle.

Anthocotyle is a worm of a very delicate, thin structure and yet with very powerful means of holding to its place of attachment, and this is probably the reason for its described rarity. Van Beneden claims only to have seen two specimens. However, if care is taken they may be found. It is extremely filmy except in the neighborhood of its large suckers, where there is considerable muscular tissue, as well as the large chitinous framework of the suckers.

It belongs to the family Octocotyliidae and the peculiarity of its armature is that while it has eight suckers, the two anterior ones are out of all proportion with the others of the set, the anterior ones being very large while the other six are very small. The anterior ones also are not of the same size, the right one being much larger than the other, and this is constantly so in all the specimens. (Fig. 10.)

The worm is about 9 mm. in length by 1.20 mm. in width at its widest point; one specimen, however, measured when mounted 12 mm. by 2 mm. The large suckers measure in diameter 1.20 mm., while the smaller ones measure .053. The head is very small, being surmounted on each side by a rather large sensory papilla. The mouth is large and semilunar in shape, the concavity being toward the anterior extremity. Somewhat posterior to the lower lip on each side is a small sucker, and still more posterior and between these is the pyriform pharynx. The oesophagus bifurcates almost immediately into ceca and in the angle thus formed is as usual the genital opening, or uterine atrium; protruding from this is a very prominent cirrus at the end of the vas deferens. The end of the cirrus is enlarged and also armed with rather long chitinous spines or spicules arranged in somewhat irregular rows. The vas deferens is large and more or less occupies the central space between the profuse vitellaria, which occupies the greater part of the body on each side. The testes not very numerous, are small and are almost entirely covered under the vitellaria. However, in one large specimen twenty could be counted.

The female genital apparatus consists of the usual organs; the ovary is club-shaped and situated at about the middle of the body, the oviduct being a continuation of the smaller end which is at first directed posteriorly, but after receiving the duct from the seminal reservoir and the vitelline ducts it proceeds across the body from left to right, to pass into the ootype. The shell gland is small and compact and very distinct. The ootype is fairly large, as is also the uterus. In one of the specimens being described a fully formed egg is seen. It is long and narrow and provided with a filament at each end which are several times the length of the egg as shown in figure 2. At the point where the worm suddenly enlarges at the neck, forming a sort of shoulder, is the opening on each side of a vagina, both of which can be traced posteriorly as far as the beginning of the vitelline ducts.

One of the main points of difference between this form and that of *A. merlucii* is first that the chitinous structure in the suckers is very different, as may be seen by the plate, and second that between the last pair of small suckers a prolongation of skin, square across the terminal and is armed with four different hooks. (Fig. 10a-b.) These are entirely absent in *A. merlucii*. The size of *A. merlucii*,



Fig. 11

FIG. 11. *AMPHIBDELLA TORPEDINIS*.



Fig. 12

FIG. 12. *AMPHIBDELLA FLUVOLINEATUS*.



Fig. 12-A

FIG. 12-A. GENITAL SCHEME OF *A. FLUVOLINEATUS*.

4 mm., as given by Van Beneden is not more than half the length of the American form, which in some cases measured 12 mm.

Measurements of *Anthocotyle merlucii americanus*.

Length	9 mm. to 12 mm.
Width	1.20 mm. to 2 mm.
Diameter of large suckers	1.20 mm.
Diameter of smaller suckers50 mm.
Egg05 mm.

Amphibdella torpedinis.

(Fig. 11)

Family Gyrodactylidae v. Ben. et Hesse.

Genus *Amphibdella* (Chatin).

In 1874 Chatin discovered and described this worm with the above family history. He found it on the gills of *Tetranarce occidentalis* and named it *Amphibdella torpedinis*. I am only writing a short description of it in order to compare it with another species of the same family which I found on the same fish and under the same conditions as *A. torpedinis*, a description of which I am giving in a separate paper.

They are totally different, although found in the same habitat in about equal numbers (see plate). As the description of this worm in any book to which I have access is rather meagre and no plate showing its anatomy is given, I am tempted to try and give a little more perfect description as I found it, also in order that it may be compared with *Amphibdella flavolineata* as given in this paper.

The form is quite graceful and about 4 mm. in length by 1 mm. in width. The anterior end is concave, in the center of which is the mouth. On each side of the head are seen three large sensory papillae, and between the posterior two is a mass of unicellular glands, which in the stained specimen is highly colored. There is also a mass of these on each side of the pharynx. The pharynx is relatively large, and the postpharyngeal oesophagus bifurcates into the intestinal ceca close to the pharynx. The genital opening is placed in the angle formed by the branching ceca and here prominently is seen the large peculiar chitinous cirrus, composed apparently of two tubes ending in three brownish hooks at the distal end of the cirrus; at its base, or at least connected with it is seen the bulbus ejaculatorius, through the center of which the seminal tube passes; immediately behind this is the ductus ejaculatorius, which is quite muscular and is somewhat sausage-shaped, although becoming quite small at each end; this receives the seminal duct from another somewhat semilunar enlargement, which may be called the posterior prostatic reservoir; this also is con-

nected posteriorly with the vesicula seminalis, which is the main reservoir of spermatozoa and it is directly in connection with the testis by means of the vas deferens. There is also a fine tube, brown in color, which extends from the junction of the posterior prostatic reservoir and the ductus ejaculatorius; this is seen to enter the cirrus at about the middle of its length. The testis is situated beside the ovary on the left side of the worm when looking at the ventral surface, it is single and the vas deferens crosses over the dorsal surface of the ovary to join the vesicula seminalis.

The ovary is flask-shaped with a long neck, which is in part the oviduct. The genital connection takes place a little anterior to the ovary and the uterus, which is quite short, ends at the edge of the genital pore in the center of the anterior part of the worm. Its mouth is somewhat funnel-shaped and appears muscular and circular.

The vitellaria are plentiful and extend from opposite the anterior part of the ovary to the disc posteriorly.

No vagina is visible. The excretory system may be distinctly seen terminating in two or three good-sized canals which extend to the sucker disc. One small canal is seen to empty on the side of the body.

The intestines seem to end in one large coecum which passes down the middle of the body cavity and ends at the junction of the middle with the posterior third of the body.

The disc is wide and muscular and connected with the body by a neck almost as wide as the body. The muscular fibres which control it are plainly visible. The disc is more or less circular on its distal face and is armed with four large yellow hooks besides several very small hooks situated at the edge of the disc.

Measurements of *Amphibdella torpedinis*.

Length	4.00 mm.
Width	1.00 mm.
Pharynx, diameter09 mm.
Pharynx, from anterior end of worm20 mm.
Ovary, length35 mm.
Ovary, width04 mm.
Testis, length20 mm.
Testis, width07 mm.
Sucker disc, width25 mm.
Sucker disc, depth13 mm.
Hooks on disc, length10 mm.
Chitinous Cirrus, length05 mm.
Chitinous Cirrus, width15 mm.

Amphibdella flavolineatus, nov. sp.

(Figs. 12 and 12A)

Family Gyrodactylidae v. Ben. et Hesse.

Genus *Amphibdella* (Chatin).

In 1874, Chatin discovered and described a small worm belonging to this family, which he found on the gills of *Tetranarce occidentalis* and which he named *Amphibdella torpedinis*.

On July 6, 1914, at the United State Fish Commission Laboratory at Wood's Hole, Mass., there was found on the gills of a large torpedo-*Tetranarce occidentalis* a great many *A. Torpedinis* and also an almost equal number of another *Amphibdella* which as far as the writer is aware has not hitherto been described. It is quite different from *A. torpedinis* and for purposes of identification the following characters may be given: Two prominent rows of light yellow colored, lobulated vitellaria, one along each side; a large armed sucker disc connected to the body by a much constricted neck; disc divided into two large lobes, and these again subdivided into several smaller lobules. On each of the lobes are two fairly large hooks, but as far as can be seen there are no other smaller hooks. The disc is joined to the body by a narrow pedicel or neck, but strong muscular bands may be seen extending from the hooks and disc well up into the body.

The worm is from 4.50 to 6 mm. in length by 1 mm. in width. The genital organs are situated chiefly in the anterior quarter of the body. The head is small and surmounted on each side of the mouth by three sensory papillae or areas. These connect with small tubes which are numerous as far as the pharynx. The pharynx is round, large and surrounded by many vascular unicellular mucus or salivary glands, which by means of long ducts open into the oesophagus and pharynx. They stain deeply and are hence prominently in sight.

The post-pharyngeal oesophagus divides almost immediately into two intestinal coeca which are long and extending down the center of the body throughout most of their course, almost to the base of the sucker disc.

The female genital apparatus occupies the triangular space between the bifurcation of the oesophagus into the intestines and between the anterior ends of the vitellarian tubes. These latter are the most prominent markings of the worm in life, giving it the appearance of having two wide light yellow lobulated stripes throughout nearly its whole length. When magnified these stripes show each to be enclosed in a sac or membrane and to be made up of large rounded lobules of vitellaria. At the anterior end the two columns come together by two slender vitelline or yolk ducts where they enter the oviduct.

The ovary is large, graceful and flask-shaped with a long neck and this terminates in the oviduct which is short and joined by the ducts from the seminal reservoir and vitellaria. The shell gland is also to be seen very distinctly near this point.

The uterus is quite short and ends near the edge of the genital atrium in the centre of the body and well into the angle at the bifurcation of the intestinal coeca. Its end or mouth is at the end of a triangular or funnel-shaped widening of the tube. In the specimen described herein an egg is observed which is oval, yellow, and in this case has a wrinkled chitinous shell. It measures .03 in length and apparently only one egg is developed at a time, for in this case no other can be seen to be in process of formation. No vagina can be seen.

The male genital apparatus also occupies the anterior portion of the worm and is a rather complex structure.

The testis, a large single one, is situated dorsally of the anterior end of the right vitellarium. The vas deferens is consequently short and leaving the testis it widens somewhat, then enters the base of the anterior prostatic reservoir or vesicula seminalis, which is large and flask-shaped, and this after coming to a quite narrow neck widens into the ductus ejaculatorius which is somewhat sausage-shaped and muscular, this terminates in a fine duct or tube which enters at its base a ball-shaped muscular structure the bulbus ejaculatorius, and through the centre of which it passes to end in the base of the chitinous cirrus, which is .05 mm. in length by .020 in width, hollow and terminating at the tip in two short hooks.

The genital connection takes place where the two columns of vitellaria connect anteriorly; this scheme or connection is shown in Fig. 12a.

As will be seen from the above description, this worm differs very materially from *torpedinis*, although found together and under the same circumstances; therefore, it would appear to be a nov. sp., for which I propose the name of *Amphibdella flavolineatus*.

Measurements of *Amphibdella flavolineatus*.

Length	4.50 to 6.00 mm.
Width	1.00 mm.
Sucker disc, width34 mm.
Sucker disc, length20 mm.
Ovary, length25 mm.
Ovary, width08 mm.
Hooks on sucker disc, length10 mm.
Pharynx, diameter10 mm.
Cirrus, length05 mm.
Cirrus, width02 mm.
Testis, length13 mm.
Testis, width09 mm.
Egg, length03 mm.

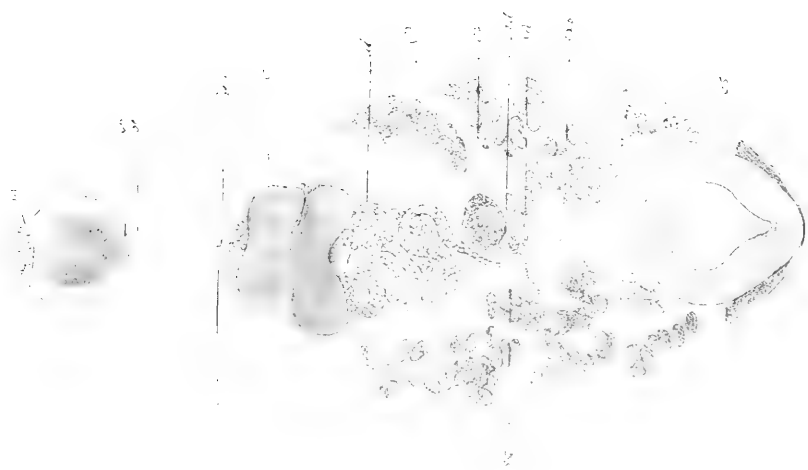


Fig. 13

FIG. 13. *PARAPHISTOMUM P. PHILLOSTOMUM*.

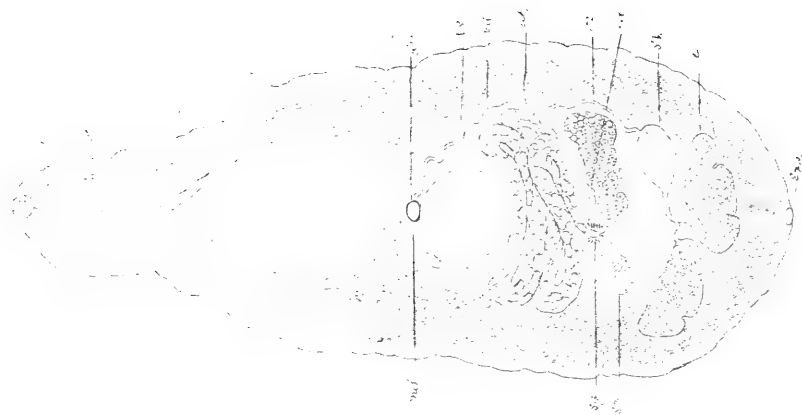


Fig. 14

FIG. 14. *DISTOMUM M. HERONINIS*.

Paramphistomum papillostomum, nov. sp.

(Fig. 13)

Family *Paramphistomidae* (Fisch.).Sub-family *Paramphistominae* (Fisch.).

Before the above nomenclature was finally settled the name of this genus had caused a considerable discussion. In 1788 a worm was discovered by Schrank which from its description seems to have been an amphistomum. He named it *Festucaria strigis*, having found it in an owl. Then in 1790 Abildgaard found a similar worm and called it *Strigea*. In 1801 Rudolphi arbitrarily ignored any previous names given to the genus and named it *Amphistomum macrocephalum*, and he also applied this name as the synonym of a great number of species reported by other observers. This apparently held until 1901 when Fischöeder, in an attempt to clear up the whole matter of name, called the genus *Paramphistomum*, family *Paramphistomidae*, subfamily *Paramphistominae*. He intended, it is presumed, that this name should include all of the former genera and species of the so-called *Amphistomidae*. Looss does not think that there was any necessity for such a sweeping change and would adhere to the name *Amphistomum*, and in this no doubt a great number of investigators will agree, although a considerable number, including many of those who think *Amphistomum* proper on account of long use would rather see the original name *Strigea* adhered to. In all up to 1889 von Linstow records twenty-eight species as being found by six investigators of whom Diesing described thirteen species and Cobbold six. These were generally found in the herbivora as the elephant, rhinoceros, horse, buffalo, deer, etc. Since then many forms have been found in birds, especially in the hawk and owl families. Only one Cephalopod, the squid, has been credited with being the host of an *Amphistomum*, namely *A. loliginis*. Only two species of turtles so far as known have harbored this worm, viz. *Chelonia mydas*, the green turtle, and *Chelonia imbricata*, the hawksbill turtle. The former is credited with two species thus far—*A. scleroporum*, Creplin and *A. spinulosum*, Looss. Creplin found it first in 1844. Braun mentions it in 1893 and 1899, also again in 1901. Looss in 1901 describes *C. mydas* as being the host of *A. spinulosum*. It was found in the colon of a green turtle on the Egyptian coast near Alexandria. In 1902 he mentions it again as being found in *C. mydas*. Shipley described it in 1905 as found in *C. mydas*.

On January 31, 1914, while making an autopsy on a very large *C. mydas* at the New York Aquarium an *Amphistomum* was found in the intestines. It was a solitary specimen, yellowish in color, thick and firm in structure and measured when fresh 10 mm. in length by 5 mm. in width. As this species of worm is not so frequently found in amphibians as in animals and birds, I therefore record its occurrence and describe it very briefly. (Fig. 13.)

The worm is oval and thick with skin smooth and unarmed, therefore I conclude that it is not *A. spinulosum*; in this it is very different except that it possibly might be that Looss each time had a young worm to describe, so also Shipley, while mine may have been a very old specimen which had lost its spines as is not unusual with some of these worms. As to its identity with Creplin's *A. scleroporum*, I do not find that it resembles it at all, although evidently belonging to the same family. The most striking features of *P. papillostomum* are its mouth and posterior sucker. The opening of the mouth is terminal and somewhat oval, and measures 0.60 mm. from side to side. The lips or margin present a number of slight or short papillae or rod-shaped projections which, parallel to one another, entirely surround the opening. They measure in length 0.02 mm. Internally the mouth opens at once into a large globular bowl-shaped structure, occupying the whole anterior end of the worm, and in this differing from many worms of the genus which have long lateral suckers or ceca. At the lower edge of this and partly within it is the pharynx. The whole giving the impression that the sucking apparatus is very powerful. The pharynx is somewhat round. There is no pre-pharyngeal oesophagus, but the post-pharyngeal oesophagus is relatively long, being 1 mm. in length before it divides into the cecal rami. These latter proceed posteriorly almost to the caudal sucker, and although much lobulated, do not give off any branches. In the middle of the angle where the ceca separate is seen the genital pore at which the mouth or anterior end of the uterus and cirrus appear, coming in different directions from behind the large testes. On account of the testes covering in the vas deferens and cirrus to so great an extent—that is, when viewing the worm from the ventral aspect—the exact structure of the cirrus cannot be made out, nor does the metraterm appear. The testes, which are two, large more or less square blocks, occupying fully half the width of the body and filling the whole space between the ceca in that region, are placed almost immediately behind the genital pore and almost in contact with one another.

The ovary is roundish, fairly large and situated on the left side somewhat, and at the junction of the anterior two-thirds of the body with the posterior third, and here, too, is the genital junction where the vitelline ducts join the oviduct and near which the shell gland is situated. The uterus coils several times from side to side across the middle of the body and is well filled with eggs which are round and yellowish in color and measure 0.02 mm. in diameter. No seminal reservoir is seen. In the centre of the body towards its caudal sucker is a large opening, the excretory pore, but the water vascular system is not much in evidence although, of course, present. The vitellaria occur in large rounded masses and they occupy, in a scattered way, both sides of the body throughout its posterior half. A very striking feature is the caudal sucker which is sub-terminal. It is pyriform in shape, base anteriorly, large and exceedingly muscular. The opening

in it is also quite pyriform in shape, the small end being posterior. This is apparently the sole means of adhesion to its host.

As far as I can make out *P. papillostomum* does not quite fit into the description given of either *A. spinulosum* (Looss) or *A. scleroporium* (Creplin). The size of *A. spinulosum* is given as 5 to 5.6 mm. in length, about half the length of *P. papillostomum*. The conformation of the internal organs does not correspond nor is the skin at all like it since there is not a spine to be found on it, neither are the circular rugae or papillae seen described as the base of these spines, nor are there any spines about the mouth. In the present worm the skin is perfectly smooth, although somewhat wrinkled, but there are no signs of papillae. If it be said that young worms often show spicules on the skin which later they lose, that probably would not apply to the circular rugae or the papillae which support the spicules. The skin is traversed from end to end by fine striae, which give it the appearance of having been sectioned by a knife with a very imperfect or finely notched edge. This is evidently owing to the muscular fibres in the skin and anteriorly cross fibres show. The mouth is very different, being surrounded by a row of very regular small papillae placed side by side, forming the lips, and no doubt they answer the purpose of feelers as well as assisting in the process of sucking. The same objections would be called up in considering the resemblance to *A. scleroporium*. The general appearance, the subterminal mouth, the round caudal sucker and narrow slit-like opening, not to speak of the internal conformation of the organs. As there have been so many species described, I feel very reluctant to add to their number, and yet there does not seem to be any proper form hitherto described in which as a species it could associate or be classed.

Measurements of *Paramphistomum papillostomum*, nov. sp.

Length	10.00 mm.
Width	5.00 mm.
Length of caudal sucker	2.20 mm.
Width of caudal sucker	2.00 mm.
Length of opening in caudal sucker	1.40 mm.
Width at base of caudal sucker	1.20 mm.
Mouth from side to side	0.60 mm.
Length of papillae of lips at mouth	0.02 mm.
Testes length	2.00 mm.
Testes width	1.00 mm.
Eggs, diameter	0.02 mm.
Length of oesophagus	1.00 mm.

Distomum macrorrhinis, nov. sp.

(Fig. 14)

During the examination of an elephant seal, *Macrorrhinus angustirostris*, on February 29, 1912, at the New York Aquarium, there were found a large number of little distomes in the intestine. They were not restricted for room for the intestine was twenty-three and a half metres in length and the only other inhabitants of this tract were a few ascarides. These were from 35 to 50 mm. in length.

The little distomes are 1.40 x 0.40 mm. and the anatomy is exceedingly simple. The anterior sucker is subterminal and occupies almost the entire anterior end. Leading from this is a short prepharyngeal oesophagus. The pharynx is not large nor is there anything peculiar about its structure, it ends in a postpharyngeal oesophagus which is very long, being at least eight times as long as the portion in front of the pharynx. At about a fifth of the length of the worm it divides into the ceca which extend to near the middle of the worm before they become hidden by the vitellaria, after which they cannot be followed but probably extend to nearly the posterior end. There is plainly visible beginning at each side of the anterior sucker a water vascular tube which extends also along the sides of the body to be lost under the vitellaria, but to terminate in the large excretory pore.

The genital organs are situated mainly towards the extreme posterior region. The female genitalia consist, as usual, of an ovary which in this case is an irregularly elongated structure which gives off the oviduct at about the middle of the body in the posterior third and this almost at once receives the duct from the seminal reservoir and the vitelline duct, and these, with the shell gland, form the genital junction. The uterus from near here winds in tubular folds loaded with eggs across from side to side several times, and finally terminates in the genital pore situated at the anterior edge of the acetabulum. Eggs measure 0.015. The vitellaria are very plentiful and extend from a short distance in front of the acetabulum and fills in most of the posterior two-thirds of the worm.

The male genitalia consist of two triangular-shaped testes situated very near the posterior end of the body cavity. They are relatively large and each gives off a vas which join to form the vas deferens which almost at once widens into a fairly large vesicula seminalis. From this the vas deferens ends in the cirrus at the genital pore.

The skin of the worm is not smooth, being thrown into wrinkles, but it is unarmed. The acetabulum is very large compared with the mouth sucker, being probably four times as large. It is situated a little posterior to the middle of the worm. Other than the oesophagus and the water vascular tubes which are somewhat branched almost the whole anterior half of the body is unoccupied with any important structures, except part of the alimentary canal and the water vascular system.



Fig. 15

FIG. 15. *MONOSTOMUM POMACANTHI*.

Fig. 16

FIG. 16. *MICROCOTYLE ANGELICHTHYS* POINSENDE.

a—Head enlarged.

Monostomum pomacanthi, nov. sp.

(Fig. 15)

On May 29, 1915, while examining a large French angel fish—*Pomacanthus paru*, from the New York Aquarium—there was found a number of *Monostoma* in the intestines. They are about 4 mm. long by 1.02 wide, are elongated, quite pointed at the head and rounded at the posterior end. The most prominent feature of the body, even as seen with the naked eye, is the peculiar clasping muscular flap on each side anteriorly, apparently intended by nature to assist the worm in keeping itself in position, or possibly in conjugation, as in the case of *Bilharzia hematobium*. The muscular fibers are very distinct, and interlace in all directions, concentrating at the point of the flap. The mouth is large and apparently strong. The oesophagus is indistinctly defined and extends one-eighth the length of the worm before it divides into the ceca. No pharynx is seen. The muscular flaps start on each side well forward in the neck, and almost at once widen so as nearly to meet in the centre of the body, then they gradually slope away, disappearing at each side at a point nearly one-half the length of the worm. In this enclosed space the oesophagus and ceca lay, and in its posterior area is the genital pore, where the uterus and cirrus terminate. The uterus is voluminous, and filled with oval eggs which each have a long chitinous filament attached to either pole. The uterus is provided with a strong metraterm near the genital pore. The vas deferens after passing behind the folds of the uterus appears anteriorly to them in a relatively large cirrus sac, this coils towards the genital pore, which is near the side of the worm. The pars prostatica is well developed, and the whole sac is well supplied with muscular tissue.

The testes are two in number situated almost at the extreme posterior end of the body, one on each side. They are much larger than the ovary, which lies in front of and between them, and here also is the genital junction. The vitellaria is distributed in the form of two large lobulated masses at the sides in front of the testes, although in some specimens masses may be seen along the sides of the body elsewhere, but generally the vitellaria are as described in front of the testes. The water vascular system drains the body from the head and terminates in a large oblong opening very near the posterior end of the body. The nervous system is not very evident. A lateral view of the worm shows it with rounded shoulders, and the flaps extending in front, almost like two short arms.

Measurements of *Monostomum pomacanthi*, nov. sp.

Length	6.00 mm
Width	2.00 mm.
Mouth025 mm.
Body across claspers	1.04 mm.

Microcotyle angelichthys townsendi, nov. sp.

(Fig. 16)

This worm, like the rest of the genus, inhabits the gills of its host which in this case was the yellow-tailed angel fish, *Angelichthys townsendi*. It is small, being only 3.05 mm. long and 0.20 mm. wide. It has a short almost straight sucker disc, coming to a sharp point which to the naked eye gives the worm the appearance of being sharp at both ends and the whole body but slightly bent still fairly thick. Only about twenty specimens were washed from the gills in the case examined. The fish was small, being only six inches by three inches, yet the worms were hardly in sufficient numbers to cause death. The head is roughly triangular, at least the most anterior portion is prolonged to almost a point, and this is provided with three tactile areas. The mouth suckers are round cuplike and appear very muscular. They are somewhat peculiar and quite different from those of most members of this genus. The two suckers are placed obliquely in the throat, and slanting from before downwards and backwards, each sucker seems to be divided in two by a slight band, and they are otherwise marked by striae, probably muscular, which run from the centre to the edge of the cuplike sucker. Anterior to these suckers in the centre of the mouth the edge is prolonged into a sort of proboscis and used probably to hold firmly the gill filament upon which it is feeding. On each side of this proboscis is another small sucker which probably has the same function as the proboscis. Behind these the pharynx is very near and is also round. More posteriorly still is the genital pore or atrium which differs distinctly from that of any of the other members of the genus and is the peculiarity of this species. The atrium is divided into two openings, the posterior one being that for the cirrus which is generally seen protruding a short distance over the edge. It is surrounded by hair-like spicules, and this opening is separated from the uterine opening superficially by a narrow band of spicules, while it can also be seen that the openings are separated by a membrane.

The uterine opening is profusely surrounded by long hair-like spicules especially in front or anterior to the pore; here the armature is in a wide dense mass. The whole genital outlet occupies almost the whole width of the worm, indeed the body is distinctly widened at this part to accommodate these structures.

The uterus and vas deferens proceed anteriorly side by side along the middle of the worm until they reach near to the atrium, the uterus generally lying along the left side of the vas throughout its course, but here it becomes more superficial ventrally and curls over the cirrus pouch to the right to make its way to the uterine outlet.

The vagina opens dorsally and centrally at a point nearly one-third the length of the worm from the head. It is relatively large and soon divides into two ducts to join the vitelline ducts or reservoir.

The ovary is placed posterior to the middle of the body and is loosely distributed in the shape of a horse-shoe. The looseness of the structure is not due to postmortem pressure, as great care was taken to prevent that. Generally as the worm lies on its back the end of the ovary on the right side gives off the oviduct which in a winding way proceeds posteriorly and over to the left side, enclosing in its folds the seminal reservoir and proceeding to the shell gland which is always in this worm particularly prominent and highly stained. On passing to the shell gland it receives the duct from the seminal reservoir and also the yolk ducts. On passing through the shell gland it curves anteriorly and proceeds along the middle of the worm to the atrium.

The vitellaria are unusually profuse extending along each side from almost opposite to the mouth to the disc posteriorly.

The testes, about twenty-six in number, are fairly large and of a roundish shape and extend from near the disc nearly up to the ovary.

On each side of the body and between the vitellaria and the internal organs along the middle of the body are two lines distinctly free of vitellaria, making a stripe along almost the whole length of the body. These lines are plainly traceable into the sucker disc and are no doubt the site of the water vascular system, although no vessels could be seen. The disc is distinctly foot-like in an extended position, but is very often held in a perfectly straight position. It is short and supports about fifty-six clasps or suckers. These are slightly different in shape from those in other species, being wider in their grasp and not so deep, although their chitinous structure is much the same.

Measurements of *Microcotyle angelichthys townsendi*.

Length	3.05 mm.
Width15 mm.
Disc length20 mm.

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SOME NEW FORMS OF PARASITIC WORMS

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Each author is responsible for the scientific accuracy
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ABBREVIATIONS

Abbreviations in explanation of plates :

b.c.—buccal sucker	ov.d.—oviduct
c.s.—caudal sucker	ph.—pharynx
c.p.—cirris pouch	p.p.—pars prostatica
cl.—cloaca or genital pore	pr.—prostate
c.—cirrus	r.p.—reservoir prostatica
b.ej.—bulbus ejaculatorius	p.s.—penis shell
d.ej.—ductus ejaculatorius	s.g.—shell gland
e.—eye	s.v.—seminal vesicle or vesicula seminalis
ex.p.—execetory pore	s.r.—seminal reservoir
ex.v.—excretory vessels	s.p.—sensory papillae
g.p.—genital pore	t.—testis
g.a.—genital atrium	t.a.—tactile area
h.—hook	u.—uterus
i.—intestine	u.g.—unicellular glands
m.—mouth	v.d.—vas deferens
m.b.—muscular bands	va.—vagina
m.g.—mucus glands	vit.—vitellaria
met.—metraterm	v.s.—ventral sucker or acetabulum
o.s.—oral sucker	v.r.—vitelline reservoir
ov.—ovary	w.v.s.—water vascular system
oot.—ootype	y.d.—yolk duct
oe.—oesophagus	y.r.—yolk reservoir

SOME NEW FORMS OF PARASITIC WORMS *

BY G. A. MACCALLUM, M.D.,

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Pathologist to the New York Aquarium.

Order—*Trematoda*.

Sub-family—*Octocotylinac*. Van Beneden et Hesse.

Genus—*Diclidophora*.

The name *Diclidophora* was created by Diesing for a worm with eight clinging discs at its posterior end, and found on the gills of many different fishes. It was in 1850 that he found two forms of this worm which he named *D. longicollis* and *D. palmata*. Kuhn, in 1829, however, reported finding one of these worms on the *Merlangus vulgaris*, and called it *Octostoma merlangi*. This, in 1859, he renamed *Octoplectanum*, and this name in 1868a-1861a Beneden called a syn. of *Octobothrium merlangi*. Cerfontaine, in 1895, named one which he found on the gills of *Labrax lupus*, *Diclidophora labracis*. Leuckart, in 1830, found one which he called *Octobothrium palmatum*, and Rathke named one he found on a *Lota molva*, *Octobothrium digitum*. From this it may be seen that a number of eminent writers have, as they fancied, given it a name, which to them, seemed to suit its characteristics best, although each new name but complicated the subject, and left the student in the absence of good plates of the worm, at a loss to know which form each writer was describing. Almost all of these writers too, had found the forms they described in foreign waters, in fish not found in American waters, and it is quite possible that on account of this habitat of the worm it may vary in form from those found on this side of the Atlantic Ocean. With what authority it is unknown, but recently biologists seem to have presumed to try and make general the establishment of the name given to a form by the original discoverer. They contend that this priority is the only way to make permanent a name given to a genus or species. There may be reason in this, but in many cases the name which has become popular, and has been adopted for a great number of years, has become familiar to students, so that it seems often to grate harshly on the ears, not to say on the memory, to be forced to use an old-fashioned name in place of a familiar one.

*The material for the following work was derived chiefly from the New York Aquarium and the United States Fish Commission Laboratory at Woods Hole, and my hearty thanks are due to Dr. Townsend of the Aquarium and the officers of the United States Fish Commission for all the courtesies extended to me.

In this case *Diclidophora* seems so much more euphonious than any of the many other names given that although it has not priority in its favor, yet if possibly it could be established as the name for the genus, it would half clear up difficulties in its study.

This trematode belongs to the sub-family *Octocotylinæ*, V. Beneden et Hesse, and to the genus *Diclidophora*. It is not found in any great numbers anywhere, in fact is almost always found singly, and consequently cannot be said to be a menace to the welfare of its host in any case. It is an ectoparasite, always being found in the gills of a number of different marine fishes, and in almost every case the collector has named it after the particular host upon which it was found.

I propose, in briefly describing the four different worms which I have found, to use the name *Diclidophora* and its origin according to its host. I may inadvertently describe a worm which has been described before, but, if so, my excuse must be the paucity of the literature, and more, the absence of good plates by which the subject may be best recognized. At its worst the name given may be classed as another synonym.

Under the name *Diclidophora merlangi*, Kuhn, in 1829 described a worm found in *Clupea alosae* in European waters. His paper is not available here, but presuming that eight worms found at Woods Hole, Mass., on twelve *Urophycis chuss* on August 20, 1915, to be the same worm, I here append a short description, and a pretty accurate plate of the same. Although not found on the same fish as that of Kuhn, and thousands of miles from the locality, yet, in order to avoid multiplying species, I have named it *D. merlangi*, assuming it to be the same.

Diclidophora merlangi

(Fig. 17)

Host—*Merluccius bilinearis*, t. h.

Habitat—Gills.

Locality—Woods Hole, Mass., U. S. A.

At rest it is a short, thick worm, very pointed at the head, oval body and with a relatively very large disc, consisting of a block from which spring eight digits which are rather long, and which each terminate distally in a circular sucker, reinforced with a chitinous structure or framework (Fig. 17), which stiffens it and makes it more powerful. They are situated four on each side of the body of the disc, and the posterior pair are very much larger and more curved than the corresponding anterior pairs which grow less as they near the body. Other than the extra curve and size of the posterior pair they are all of nearly the same form (Fig. 17). The mouth is small, yet has a conspicuous sucker on each side, and the entrance to the pharynx is well outlined. Almost immediately behind these appears

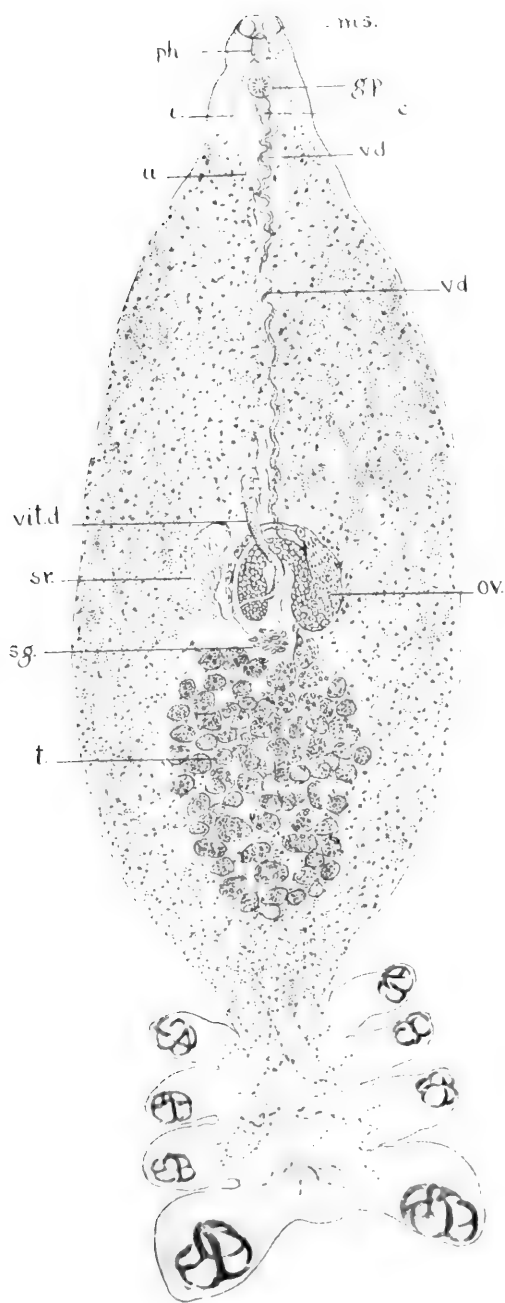


FIG. 17. *DICLIDOPHORA MERLINSJI*

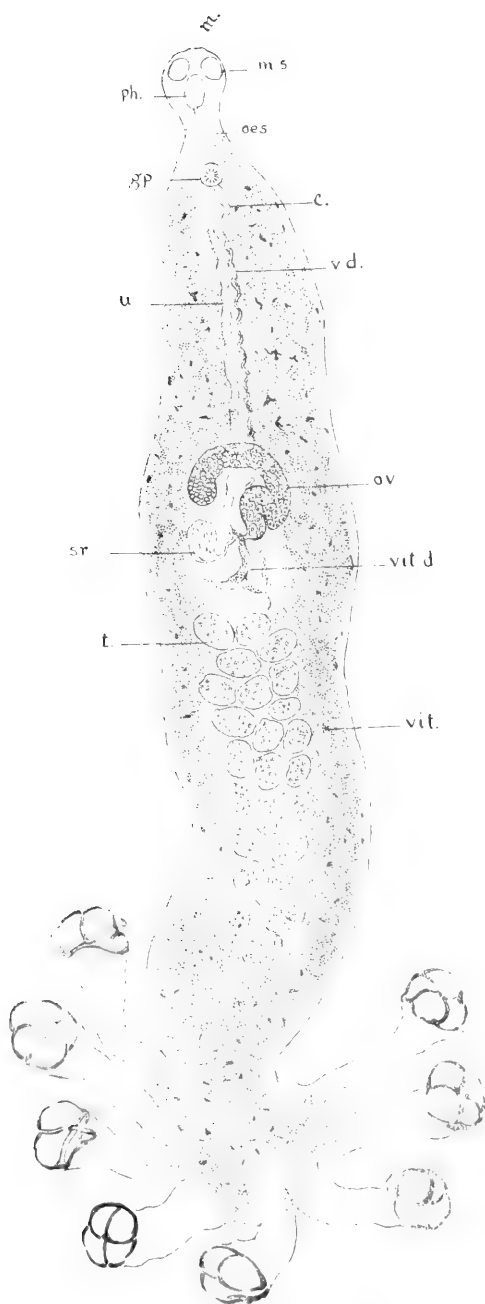


FIG. 18. *DICLIDOPHORA PRIONOTI*.

the cirrus in the angle of division of the ceca, which takes place from the back of the pharynx, and without any intervening oesophagus. The cirrus is armed at its end with a coronet of thirteen to fifteen double curved hooks (Fig. 17). The vas deferens is large and much coiled, and plainly visible leading anteriorly from the testes, which number one hundred or more. The vagina is not certainly seen. The ovary is centrally situated, and is coiled upon itself, the oviduct being given off from the anterior end, and this turning backwards receives the duct from the seminal reservoir, and that of the vitellaria, on its way to develop into the ootype. This latter is surrounded by the shell gland as usual and continues anteriorly to end at the genital pore, where also is seen very prominently the end of the armed cirrus. The egg is long and narrow, and is provided with a short filament at its posterior pole. The vitellaria are very profuse, covering almost the whole body, and are interspersed throughout with dark colored pigment spots.

Measurements of *Diclidophora merlangi*

Whole length of body, including disc ..	7.00 mm.
Width	2.40 mm.
Length and width of disc	2.00 mm.
Length of posterior digits	1.00 mm.
Width of posterior digits60 mm.

Since writing the above I desire to say that on December 17, 1916, I found on the gills of *Lota maculosa* a rather dilapidated specimen of what seems to answer to the description given of *D. palmata*. As far as I can judge from a study of the worm, I do not think it corresponds with any of the four worms I have described.

Diclidophora prionoti, sp. nov.

(Fig. 18)

Host—*Prionotus carolinus*.

Habitat—Gills of marine fishes.

Locality—Woods Hole, Mass., U. S. A.

On August 3, 1913, there were found on the gills of a sea robin two *Diclidophora*. They were rather small, measuring only 4 mm. from mouth to end of disc x .60 wide. The longest pedicle measures .60 although they are nearly of equal length, thus differing from *D. merlangi*. The head is comparatively large, with the mouth somewhat subterminal and with a large sucker on each side. The pharynx is very close to the mouth indeed appears to open into it. The oesophagus is distinct, and very soon divides into the ceca, which disappears at once beneath the very profuse vitellaria which are almost always pres-

ent in these worms from the pharynx to the end of the disc and often extending into the pedicles. The cirrus is as usual placed in or very near the genital pore, and is armed with a circle of double hooks. The uterus opens at this pore. The ovary is a coiled structure in the center of the body, and the genital junction is plainly visible. The testes are relatively large, and about twenty-five in number. Each digit in the disc is provided with a sucker at its distal end, which is fortified by the usual chitinous framework of hook-like structures. The digits are slender and nearly equal in size. They arise from a more or less quadrilateral block showing numerous muscular bands running up into the body and which control the function of the digits with their suckers.

Measurements of *Diclidophora prionoti*

Length over all	4.00 mm.
Width60 mm.
Length of pedicle in digit60 mm.
Number of hooks in coronet of cirrus	13

Diclidophora cynoscioni, sp. nov.

(Figs. 19 and 19a)

Habitat—Gills of marine fishes.

Host—*Cynoscion regalis*, Squeteague or Weak fish, t. h.

Locality—Woods Hole, Mass., U. S. A.

On August 26, 1914, at Woods Hole, the above worm was found on the gills of a *Cynoscion regalis*, squeteague. It was alone, and proved to be a very slender attenuated form, quite different in general form from other members of the family. It is about 9 mm. long, including the disc and digits, and in width it is only .10 mm. The disc is 1.15 mm. long, and each digit is about 1 mm. in length, and in all these digits, as in all of the other three forms described here, the sucker at the end of the digit is about one-half wider than the body of the digit. The mouth is different from that of the other three forms presented in this paper, in being a comparatively wide, flaring, terminal opening, and just within its margin on each side is a sucker. A short distance posterior to the mouth is the pharynx, and behind this a rather long oesophagus which divides, as usual, into two ceca, and in the angle of this division is seen the cloaca. The hooks at the end of the cirrus are disposed as in the other forms, but in the specimen at hand it is almost impossible to count them. The ovary is a somewhat horse-shoe-shaped structure, with the convex portion of the curve directed anteriorly. It is situated in the middle of the body at the junction of the anterior quarter of the body with the posterior three-quarters. The oviduct passes backwards at first until it receives the ducts of the sem-



FIG. 10. *Zonitoides phaeocyanosoma*. FIG. 11A. Sucker in ventral view.

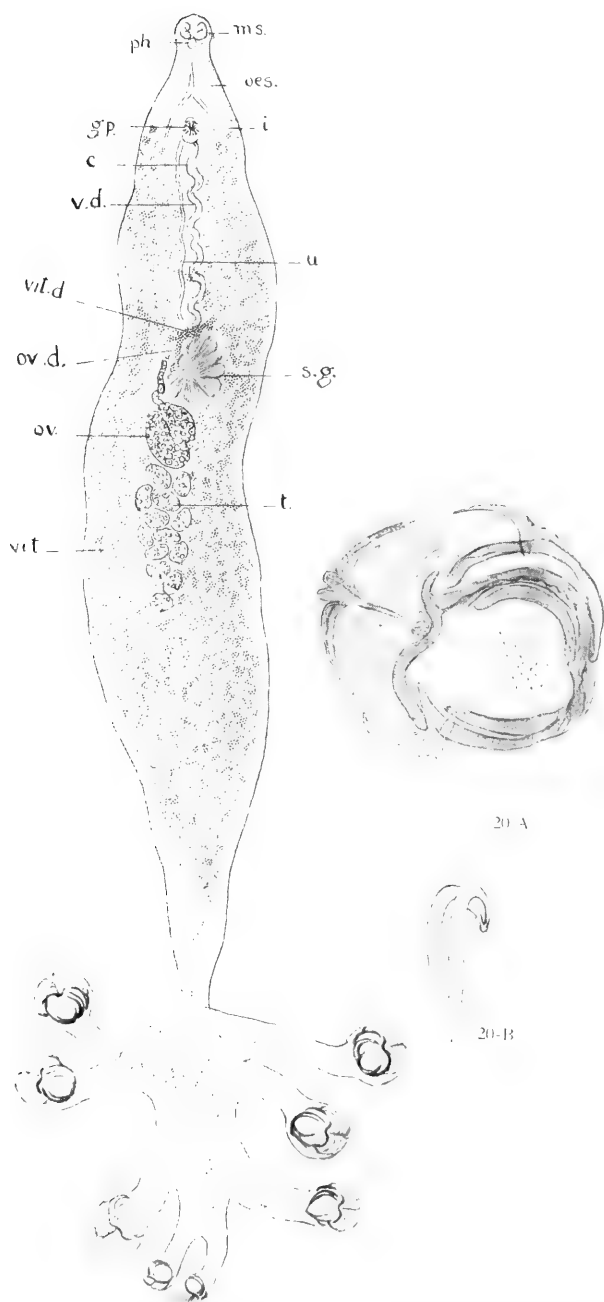


FIG. 20. *DICHDOPHORA NEOMAFENSIS*. FIG. 20 A. SUCKER ENLARGED.
FIG. 20 B. ONE OF THE HOOKS SURROUNDING THE CIRRUS.

inal reservoir and vitellaria. It then passes anteriorly in the form of the uterus to the cloaca. No egg is seen. The testes are numerous, many more than shown in the plate, being covered in by the vitellaria they are almost impossible to count, but there are probably fifty. The vitellaria, as is usual in these worms, are very profuse. The disc is a very delicate structure, and the suckers are very beautiful, owing to the peculiar shape of the chitinous framework and the regular muscular fibrils running from one part to the other. The usual muscular bands can be seen extending up into the body by which the motion of the digits is controlled.

Measurements of *Diclidophora cynoscioni*

Length of body over all99 mm.
Width10 mm.
Length of disc	1.15 mm.
Length of the longest digit	1.00 mm.

Diclidophora neomacnis, sp. nov.

(Figs. 20, 20a and 20b)

Host—*Neomacnis analis*, t. h.

Habitat—Gills of marine fishes.

Locality—Key West, Florida.

On May 4, 1915, the above worms were found on the gills of a mutton fish—*Neomacnis analis*. It is of a very beautiful shape, and differs in several particulars from other members of the family.

The mouth is very small, the anterior end of the worm being very attenuated. In other particulars, however, the mouth is of the same structure as in other worms of the family. The pharynx is situated very near the mouth, and the oesophagus is rather long before it divides into the ceca, which very soon disappears behind the profuse vitellaria which in these worms are so generously bestowed.

At the angle of the ceca is situated the genital pore, partially covered by the protruding head of the cirrus with its coronet of twelve pairs of double hooks. These hooks, while in pairs, are peculiarly united at their points into one point, presumably to give greater strength. The mouth of the uterus appears at the posterior edge of the genital pore—no eggs were seen. The ovary is a coiled mass situated a little behind the junction of the anterior third with the posterior two-thirds of the body and the genital junction is anterior to this. The oviduct passes through an unusually large ootype and shell gland. No vagina can certainly be located. The testes are much covered by the vitellaria so that it is with difficulty they are counted, but there are probably about twenty-five of them.

The body becomes very attenuated posteriorly at its junction with the disc, being indeed only .20 mm. in width at this point. The disc is in many particulars peculiar. It appears quite hand shaped, the junction with the body being distinctly marked off from the more or less square shaped palm of the disc by a ridge across at this point. There are, of course, eight digits, the first three on each side being much larger and longer than the two posterior ones, which are relatively quite small, about one-half as long and wide as the others. The longest digit is about 1.20 mm. long x .40 wide, and the shortest is .60 long x .20 wide. The suckers or bothria are nearly twice as wide as the digit, and each is a most beautiful structure, the chitinous costae being arranged in a very complicated and ornamental way, and especially so as to add to the strength of the sucker. It is barely possible that this worm may be the *D. palmatum* described so meagrely by Diesing, but, if so, the description does not indicate it. The vitellaria extend into the disc even up into the digits.

Measurements of *Diclidophora neomaenis*, sp. nov.

Body and disc together	9.00 mm.
Width, widest part	1.00 mm.
Width, next the disc20 mm.
Longest digit length	1.20 mm.
Shortest digit length60 mm.
Widest digit length20 mm.
Narrowest digit length10 mm.

Encotyllabe pagrosomi, sp. nov.

(Fig. 21)

Sub-family—*Encotyllabinae*.

Genus—*Encotyllabe*. Diesing, 1850.

Host—*Pagrosomus auratus*, t. h.

Habitat—Mouth and throat.

Locality—Australian waters.

As I have four good specimens of this worm mounted, which were found on a snapper *Pagrosomus auratus* taken in Australian waters, collected by Dr. W. G. MacCallum, and as I do not find a picture of this strange form which is at all like it, I give a sketch of it here. It is generally found in the mouth of its host, and is said to be very active in its movements. Its large clinging sucker or disc fortified with two large hooks would certainly enable it to retain its position wherever it chose to locate. In no sketch of the worm have I seen any portrayal of its anatomy, and the fact that some mistakes appear to have been made renders it necessary to try and correct them. While

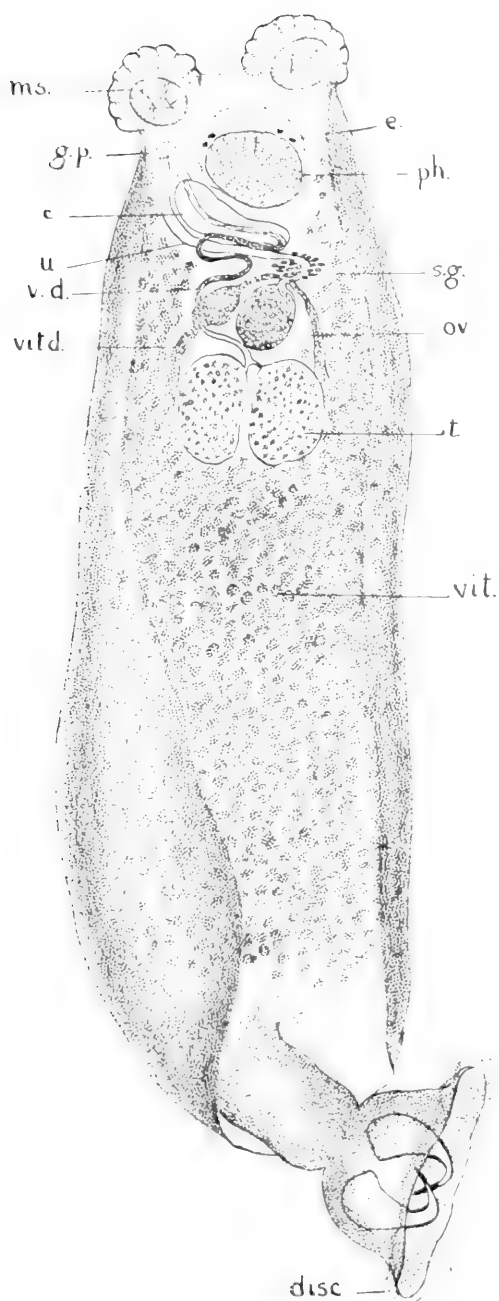


FIG. 21. ENCOEYLLIUM P. (P. 80 M.)

on this part of the description I too have to apologize for my illustrations because of two mounted worms from which the artist was working—one a ventral and the other a dorsal view. He, through some inattention, sketched the genital organs from the dorsal side, the worms having been rendered transparent. The rest of the worm was sketched from the ventral aspect. Of course this makes little difference except with the cirrus and genital pore, which are made to appear on the right side of the worm, when really they should be shown on the left side. With this exception, he has made a very realistic picture.

Beginning at the head, one is at once interested in the two peculiar fan-shaped structures, which partly surround the two powerful suckers at their bases, their function unknown. These suckers are not stalked in this species, as Diesing says, but are very protrusible and may be withdrawn quite below the surface, indeed they are then quite cupped.

The pharynx is large and is also a very powerful sucking structure, taking the place of the mouth. It also is probably protrusible, and is indeed surrounded by a membranous margin or fold which aids in excluding air or water while the pharynx is in action. Immediately anterior to the pharynx are seen four ocular spots or eyes. Almost immediately behind the pharynx are the genital organs which, with the vitellaria obscure the ceca from sight almost entirely. On account of the profuseness of the vitellaria throughout the whole body one cannot follow the intestines. There are two large oval testes situated side by side in the centre of the body at about the junction of the anterior quarter with the posterior three-quarters of its length and immediately in front of and between them is the round ovary, much less in size, still very prominent. The oviduct is short, but is surrounded by a profuse shell gland and merges into the uterus which terminates at the cloaca on the left side of the neck and just posterior to the left sucker. No egg is seen. The vitelline ducts are very large indeed, in all of the specimens a relatively large block of vitellarium is seen right beside the ovary as if it were a reservoir. No seminal reservoir or vagina is seen.

It has been said that in this family *Encotyllabinae* the genital pore is always central, such is not the case in the specimens being described, but, as I have explained, is evidently in some species lateral. The cirrus is enclosed in a large pyriform sac, with the base posteriorly and the vas deferens, which coils widely in front of the ovary before entering the base of the sac terminates in a cirrus with a well marked prostatic portion at the cloaca.

Of course the forms described by Diesing and others as found on *Pagellus centrodonotus* in the Mediterranean Sea may not be quite the same form as those found on another host ten or twelve thousand miles away.

Another important point is that in these specimens there are no hooks at the genital pore, as described by Beneden and shown in Braun's Trematoden copied from V. Beneden. All these points of difference would indicate that the present worm is of a different species from *E. pagelli*.

The disc or posterior sucker is large and connected to the body by a long and strong muscular pedicel or stalk. The sucker itself is more or less round, is hollow, and has projecting from its posterior margin a fairly wide band or membranous extension. Inside the muscular portion of the sucker are two large powerful hooks pointing toward each other. They show at their attachment a strong mass of muscular tissue which seems to extend up into the stalk and become incorporated into its muscular structure, so that the hooks and sucker may be under the control of the worm.

The host of this worm, the Snapper, *Pagrosomus auratus* is a very different fish from the Red snapper of the West Indies. It is a large rough looking fish, but is considered one of the best food fishes of the east. It sometimes reaches a weight of thirty pounds.

For the purpose of classification this worm may be said to be elongate. Surrounded almost throughout its whole length on the dorsal and part of the ventral surface by a sort of soft carapace or mantle which extends from the neck to the posterior end of the disc stalk, large terminal disc with two large hooks.

Measurements of *Encotyllabe pagrosomi*

Length	5.40 mm.
Width	1.60 mm.
Width of head	1.00 mm.
Diameter of pharynx30 mm.
Diameter of disc80 mm.
Length of stalk60 mm.
Width of stalk40 mm.

Tetrarhynchus narinari, sp. nov.

(Fig. 22)

Host—*Actobatis narinari*, t. h.

Habitat—Spiral valve.

On July 20, 1916, there were found in the spiral valve of a large *Actobatis narinari*, Euphrasen, spotted sting ray several small cestodes, and among them the subject of the following short sketch. This is a small tetrarhynch of most unusual form. The head is composed of four bothria, through the center of which pass four tubes containing the proboscidae, which arise posteriorly from four oval or oblong mus-

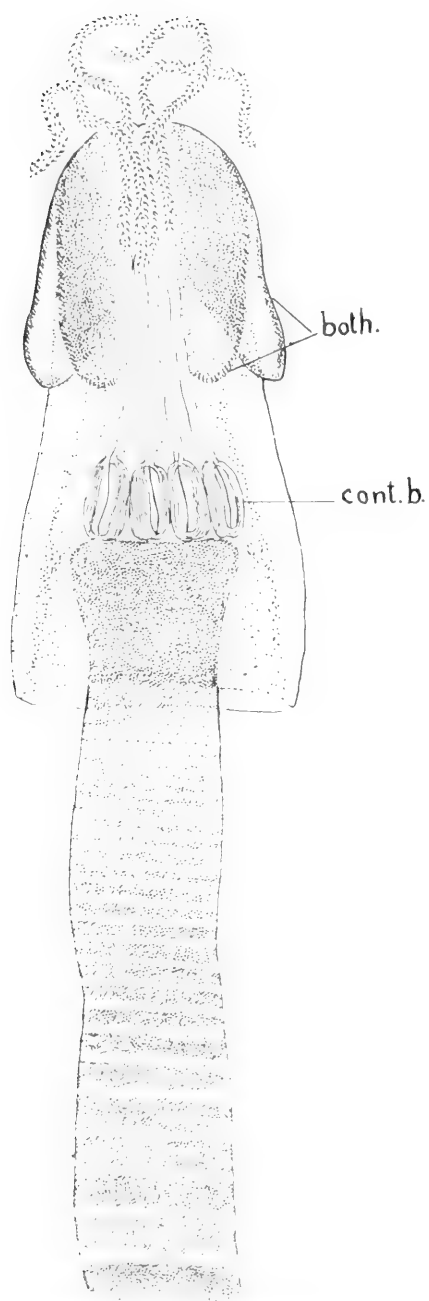


FIG. 22. *ULTRARHYNCHUS NIKINARI*

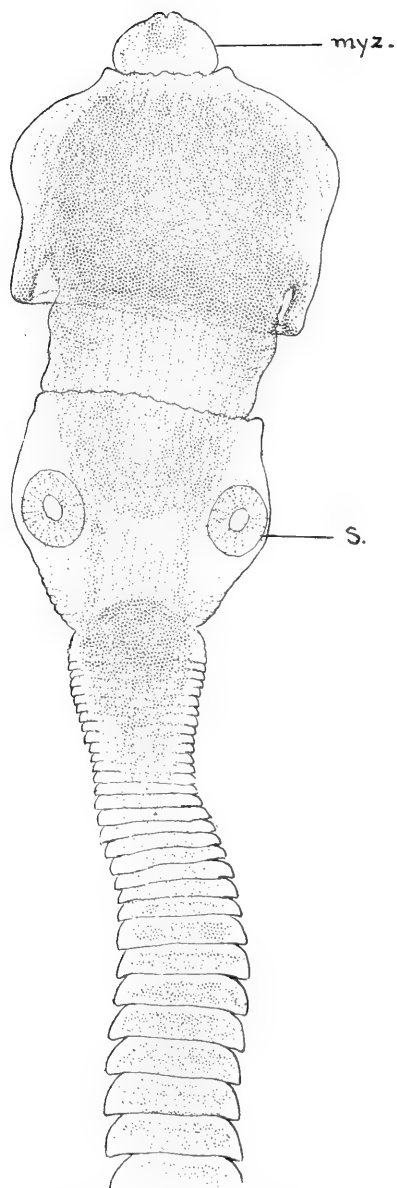


FIG. 23. *TENIA NARINARI*.

cular retractile bulbs. They are not only retractile, however, for they also have the power of forcing the proboscidae forward and outside of the head and of boring into any mucous or other tissue which the worm chooses to fasten upon, and from which they hang in the intestinal fluid from which by osmosis they derive their nourishment. It is a remarkable provision of nature that when the worm wishes to change its point of attachment it has the power of withdrawing the proboscidae. They are armed thickly with sharp hooks whose points are all directed backwards, so that they slide back into the four tubes with the greatest facility. This, of course, is nothing new, for it is true of all the tetrarhynchs.

In this case the bothria along their margins are all armed with fine spines closely set together, giving the margin a serrated or file-like appearance, and these fine spicules are all directed backwards to assist in preventing the worm from losing its point of attachment. The muscular bulbs at the posterior end of the tubes of the proboscidae are also on part of their surface covered with rows of these fine spicules. The bulbs are mounted on a widened solid portion of the strobila, and almost immediately posterior to this mass the regular striations of the strobila begin, very narrow at first, but gradually become wider apart so that at a distance of 5 mm. from the commencement of the strobila the segments are .40 mm. wide. Another very strange provision in the anatomy of this head is that of a curtain or circular cape which hangs from about the middle of the bothria above, down to the beginning of the strobila posteriorly. What the object of this is it is hard to decide. No ripe proglottids were seen.

Measurements of *Tetrarhynchus narinari*

Length of head	1.00 mm.
Width of head40 mm.
Length of strobila recovered	10.00 mm.

Tenia narinari, sp. nov.

(Fig. 23)

Host—*Actobatis narinari*, spotted sting ray, t. h.

Habitat—Spiral valve.

On examining an *Actobatis narinari* in May, 1916, there were found in the spiral valve a small cestode—a tenia, which from its peculiar formation of head deserves recording. Protruding from the extreme anterior portion is first a myzorhynchus, which is undoubtedly protrusible. It is comparatively large. The rest of the anterior surface of the head is smoothly convex, and the head is helmet shaped with a delicate circular transparent veil which hangs down before the

helmet-shaped portion, and is apparently loose at the bottom. Next comes an oblong portion, which has four circular unarmed suckers. This portion is then followed by the strobila which is lacinated, that is, it consists of segments which are very narrow at first, but shortly widen and overhang on their edges the following segment or proglottid. No proglottids were on these specimens sufficiently developed to enable me to recognize the anatomical arrangement of the structure.

Only seven mm. of this worm were recovered.

Measurements of *Actobatis narinari*

Width20 mm.
Length of head	1.20 mm.
Width of head60 mm.
Length of proglottids30 mm.
Width of proglottids60 mm.

Loimos salpinggoides, gen. et. sp. nov.

(Figs. 24 and 24a)

Order—*Trematoda*, (Rud.)

Sub-order—*Heterocotylea*, (Mont.)

Host—*Carcharhinus obscurus*, Dusky shark, t. h.

Habitat—Gills.

Locality—Woods Hole, Mass.

On August 7, 1916, while examining a large seven-foot *Carcharhinus obscurus*, dusky shark, at the United States Fish Commission, Woods Hole, Massachusetts, there were found on its gills a great number of small worms which appear to have been undescribed hitherto. There must have been thousands on the gills, for probably a hundred or more were rubbed off in the washing. As they are very fragile, a great many must have been destroyed in this process. It is a small filmy worm with a relatively large trumpet-shaped sucker, on the outer and posterior edges of which are two large hooks, while around the margin are a number of very small hooklets. It is generally a little curved or bent from end to end. The mouth is terminal, and between it and the pharynx is a moderately long oesophagus. The mouth is provided with two circular and strong suckers just inside the lips, one on each side, and these are joined by a band. Under slight pressure these are plainly seen (Fig. 24a). The pharynx is fairly large and is divided by ridges on the surface. The post pharyngeal oesophagus is short and divides into the ceca, which extend to near the posterior end. The genital pore is situated to the right of the anterior end of the pharynx, viewing the worm ventrally. There are two testes, the

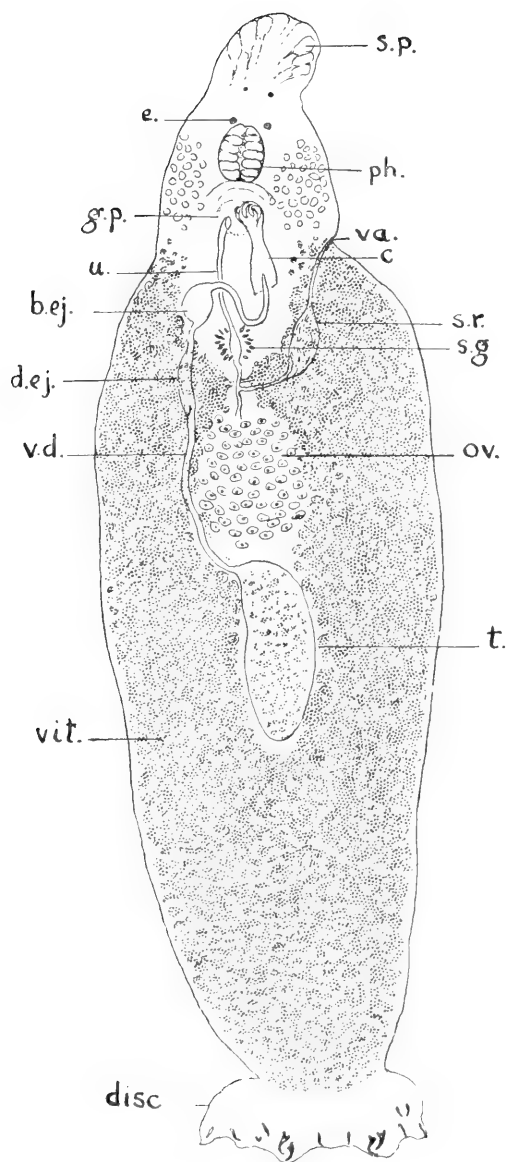


FIG. 25. DIPLECTANUM TYLOSURI

vasa efferentia, of which unite and proceed to the vesicula seminalis, a flask-shaped structure situated a short distance posterior to the division of the ceca. From this the vas deferens passes dorsally and anteriorly to the pharynx, terminating in the cirrus at the genital pore. The ovary is about half the size of each testis, and is situated anterior to them. From the anterior side of the ovary the oviduct arises and is shortly after its origin surrounded by the shell gland after receiving the duct from the vitellaria. It then terminates in the flask-shaped uterus, which, by its long neck, terminates in the genital pore. There was no vagina or seminal reservoir seen. The vitellaria are rather sparse, but extend from near the pharynx on each side to near the disc, posteriorly. The sucker at the posterior end is comparatively large and funnel or trumpet shaped, and is controlled by numerous muscular longitudinal bands which extend well up into the body. Its margin or rim is muscular and appears somewhat in folds or rolls, while the extreme margin of the structure extending a short distance beyond the muscular rim is apparently a mucous membrane. The two large hooks seen here have their basal attachment to the muscular rim as do the small intervening hooklets.

A short distance anterior to the disc is seen the excretory pore or outlet of the water vascular system with the various small vessels leading to it. The egg, which appears to be single, is generally present in the uterus, and is yellow, of an oblong shape, rounded somewhat at the ends, and is provided with a short hooked filament at its posterior end, sometimes at both ends.

Measurements of *Loimos salpingoides*

Body length	4 to 4.50 mm.
Body width40 mm.
Disc width60 mm.
Egg length060 mm.
Egg width020 mm.
Width of head20 mm.
Length of large hooks010 mm.
Width of large hooks005 mm.

Diplectanum tylosuri, sp. nov.

(Fig. 25)

Order—*Trematoda*.

Genus—*Diplectanum*.

Family—*Gyrodactylidae* V. Ben., et Hasse.

On May 4, 1916, while examining a silver gar, (*Tylosurus marinus*), its gills were found to be very extensively infested with diplectana, which indeed were so numerous that they undoubtedly caused

the death of their host. These parasites which are always ectoparasitic are very small, being generally not more than 0.50 mm. to 1.60 mm. long by 0.10 mm. to 0.20 mm. wide. Still, on account of their numbers, they are able to drain the fish of sufficient blood to cause its death. This they do by attaching themselves always to the delicate membrane covering the gills, through which, of course, the whole blood of the fish must pass to be aerated.

The worm, like other members of the family, is rather conical in form, being quite small at the anterior or head end, and gradually becoming wider until towards the posterior end, where it becomes narrower again, to terminate in the tubular clinging disc. This portion of the worm's anatomy is like that of the other members of the family, more or less hollow, although stiffened by chitinous blocks which help

NAME	AUTHOR	LENGTH OF BODY	WIDTH OF BODY	WIDTH OF HEAD	CAUDAL DISC		
					LENGTH AND DIAMETER	NUMBER OF HOOKS	LENGTH OF CIRRUS
<i>D. aequans</i> In 1857	Von Wagener	1-4 mm.			.13 mm. long .15 mm. wide	4 hooks .06 long	0.20 mm.
<i>D. pedatum</i> 1857	Von Wagener						
<i>D. echeneis</i> 1857	Von Wagener	½-1 mm.					
<i>D. aculeatum</i> 1889	Par & Perugia	1 mm.					
<i>D. sciacna</i> 1863	Ben & Hesse	0.5 mm.					
<i>D. leutbis</i> 1914	G. A. MacC.	.75 mm.	.10 mm.	.02 mm.	.08 mm.	4 hooks .010 long	.04 mm.
<i>D. lactophrys</i> 1914	G. A. MacC.	1 mm.	.10 mm.	.02 mm.	.15 mm.	4 hooks .020 long	.10 mm.
<i>D. balistes</i> 1914	G. A. MacC.	.55 mm.	.09 mm.	.02 mm.	.035 mm.	4 hooks .015 long and spines	.04 mm.
<i>D. longipb allus</i> 1914	G. A. MacC.	.95 mm.	.15 mm.	.05 mm.	.08 mm.	4 hooks .020	.25 mm.
<i>D. plurocittum</i>	G. A. MacC.	1.60 mm.	.20 mm.	.05 mm.	.025 mm.	4 hooks .020 long	.02 mm.
<i>D. tylosuri</i>	G. A. MacC.	.60 mm.	.10 mm.	.05 mm.	.07 mm.	4 hooks and a number of spines .020	.03 mm.

to give support to the various hooks which in this region are attached and which serve for the support of the worm in its connection with the gills. There are usually four large hooks here, two in front and two behind which extend slightly beyond the posterior margin of the disc, but there are also a number of small hooks and spines arranged in some cases possibly, in rows in the inner margin of the disc, which also seem to assist in retaining the worm in position. Their position, however, is under the control of the worm and can be directed to act on the ventral or dorsal side as needed. The large hooks are about 0.05 mm. or 0.06 mm. in length. *D. acquans* is provided with a structure above or part of the disc which other members of the family, so far as I have observed, have not. That is a more or less conical structure covered with rows of prickles which assist in the worm's adherence in place.

TESTES	VAGINAL APERTURE	CLOACAL APERTURE	EGGS	HOST
Single 0.12 mm. by 0.10 mm.	Left side	Median ventral		<i>Labrax lupus lulis</i> sp.
		"		<i>Chrysophrys aurata</i>
		"		<i>Sargus rondeletii</i>
		"		<i>Coreina nigra</i>
		"		<i>Sciaena aquila</i>
Single oval post ovary	left side at junction of anterior and middle $\frac{1}{2}$	"		<i>Tentis hepatus</i>
Single oval post ovary	"	"		<i>Lactophrys tricorns</i>
Single oval post ovary	"	"		<i>Balistes Carolinensis</i>
Single oval post ovary	"	"	.02	<i>Chaetodipterus taber</i>
Single oval	"	"	.02 .03	<i>Anisotremus virginicus</i>
Single oval	left side	"		<i>Tylosurus marinus</i>

The head is rather pointed and has on either side three or four sensory papillae or areas from which apparently small ducts lead towards the oesophagus. This latter organ is long, extending from the terminal mouth to the pharynx, and probably the small ducts spoken of may carry as their secretion mucus for lubrication. The pharynx is apparently a strong structure, probably used in the function of sucking. The intestinal ceca start almost at once from its posterior end, and some are hidden in the very abundant vitellaria which fill up the greater part of the body. In front of the pharynx are the usual four eye spots arranged in a square. Also on each side of the pharynx are four more unicellular mucous glands, each sending a duct towards the pharynx. Almost immediately behind the pharynx, in the angle of the dividing ceca, is the genital cloaca with the external opening of the uterus, and overhanging it a peculiarly shaped chitinous cirrus. The cirrus is quite different in form from that of any other member of the family thus far observed, and will serve on this account as a certain point in the diagnosis of the species.

There is but one testis, which is situated posterior to the ovary and the vas deferens soon after its origin widens into a ductus ejaculatorius, this again narrows before passing into the round bulbus ejaculatorius, from whence it terminates in the posterior end of the cirrus. The cirrus is not long, but terminates in an enlarged end, which is divided into four hook-like branches which are incurved.

The ovary is rather loosely constructed, situated about the middle of the worm. It gives off the oviduct from its anterior surface, and the genital junction with it and other seminal and vitellarian ducts is immediately anterior to it, and here too the shell gland surrounds the ootype, but no egg is seen in this case. The vagina appears here, as the worm is lying on its back, on the left side of the ventral surface. It is probably always situated on the left side, and any other position given is owing to whether viewed with the worm in the dorsal or ventral position, which is at times difficult to determine. The seminal reservoir is on the same side as the vagina, anterior to the ovary.

Measurements of *Diplectanum tylosuri*

Length of body	0.60 mm.
Width of body	0.10 mm.
Width of head	0.05 mm.
Length of caudal disc	0.040 mm.
Width of caudal disc	0.065 mm.
Diameter of testis	0.02 mm.
Length of cirrus	0.03 mm.

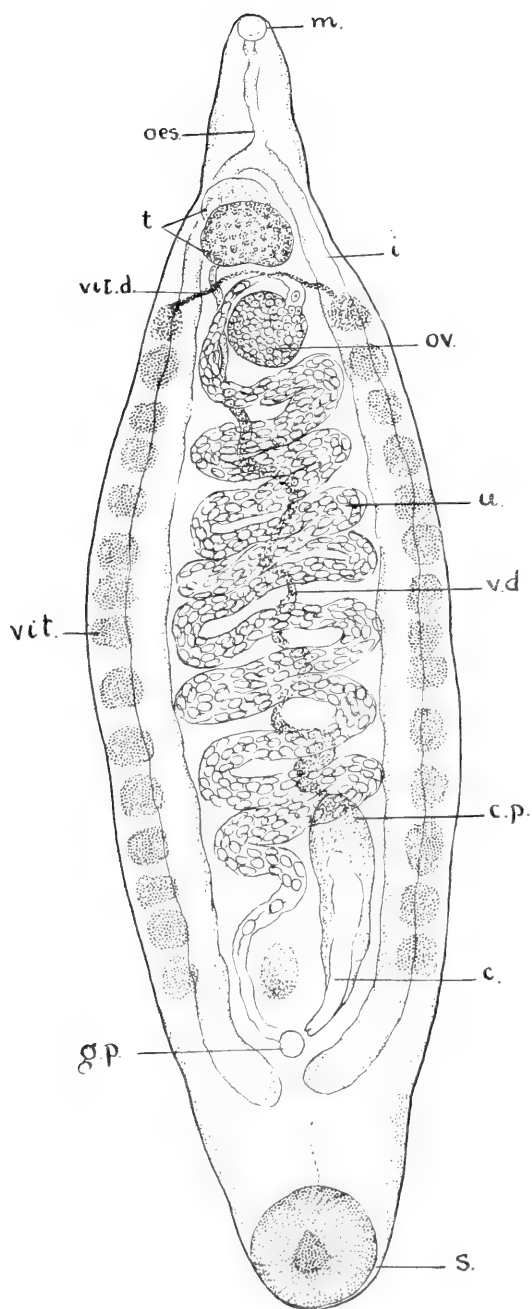


FIG. 26. *PARAMPHISTOMUM ASPIDONECIES*.

Paramphistomum aspidonectes, sp. nov.

(Fig. 26)

Family—*Paramphistomidae* (Fisch.).Subfamily—*Paramphistominac*.Genus—*Paramphistomum*.Host—*Trionyx aspidonectes ferox*, t. h.

Habitat—Oviduct.

Locality—New York Aquarium and brought from the south.

Paramphistoma are very common in many of the *Herbivora*, also in birds, but not quite so common in reptiles, yet they are known in some turtles. On May 10, 1916, there were found in the oviduct of *Trionyx aspidonectes ferox* four small worms whose habitat was rather curious. The host was a female soft-shelled turtle with an immense number of eggs in all stages of development. The oviducts were very long and very much coiled, and high up in these tubes were found the worms which proved to be *Paramphistomidae*, and which presented so many peculiarities that it is necessary to put them on record as a new species.

The anatomy is unusual as will be seen by the description of the organs and their location. The mouth is subterminal and followed by the oesophagus without a pharynx. The oesophagus is fairly long and divides at the base of the neck into the ceca, these are, however, dorsal to the two testes which are thus seen to be very near the anterior portion of the worm; they are relatively large and irregularly round. The vas deferens passes posteriorly in a tortuous course to the base of the cirrus sac, which is large and encloses a large cirrus; this latter organ is directed towards the genital cloaca, which in this case, unlike others of the family is situated near the posterior end of the body, and almost between the posterior ends of the intestines.

The uterus, which is voluminous and filled with eggs, opens also into this cloaca. The eggs are yellow, oval, and provided with a long cilium at either pole. The ovary is globular and almost as large as either testis; it is situated almost immediately posterior to the testes, leaving a space in which is seen the genital junction. The vitelline ducts are plainly visible, but no seminal reservoir or vagina is seen. The vitellaria are arranged in peculiar roundish masses in a single row along each side of the worm throughout the greater part of its length. The water vascular system is seen to terminate or open apparently in the posterior sucker disc. This structure is large, circular in shape with a pyriform opening, apex anterior. The whole worm appears of a very delicate almost translucent character; the skin very delicate although covered with very small spines which are more apparent in some specimens than in others. For the purposes of classification it may be said to have two testes situated anteriorly, genital cloaca posterior, ovary

anterior, skin spiny and vitellaria in a single line of rounded masses along each side.

Measurements of *Paramphistomum aspidonectes*

Length of body	3.00 mm.
Width of body80 mm.

Acanthocotyle bothi, sp. nov.

(Fig. 27)

Host—*Bothus maculatus*.

Habitat—Gills.

Locality—Woods Hole, Mass.

During a further study of more and better material of this obscure form obtained at Woods Hols, Mass., United States Fish Laboratory, 1915, I am able to add to and correct some points in its description which appeared during 1913 in the *Centralblatt für Bacteriologie u. Parasitenkunde*, Berlin.

Owing to the fact that the body cavity is so completely filled with vitellaria from the disc to the pharynx and from the great number of testes, it was with the material then at my disposal almost impossible to define the various internal organs.

I regret to find that some mistakes were made which are so important that they must be corrected.

The genital pore instead of being on the right side of the neck is certainly median, a short distance posterior to the pharynx and between the branches of the ceca. It is about midway between the ovary and the pharynx. Overhanging the genital pore is a peculiarly shaped chitinous structure from which the real cirrus (Fig. 27) coils, emerging from near its spiny point. The base of the chitinous case receives the vas deferens and possibly acts as a *bulbus ejaculatorius* and a short distance posterior to this is a fusiform seminal vesicle. The *vagina* is seen at the right side opposite the ovary and after dilating into a widened portion the seminal reservoir joins the oviduct shortly after its origin. The vitelline ducts emerge from the vitellaria on each side a short distance in front of the ovary and proceed backward in a V-shaped form to join the oviduct before it enters the ootype. The pharynx is a peculiar bowl-shaped structure which, on a lateral view, shows around the middle of its whole circumference a line which runs in a regular scalloped direction. The margin or mouth is also evenly scalloped. This constitutes the lips of the mouth, and they are very protrusible. The head or portion anterior to the pharynx is capable of curving itself from the margins so as to hold firmly anything it may be attached to or for the purpose of concentrating the functional efforts of the pharynx.

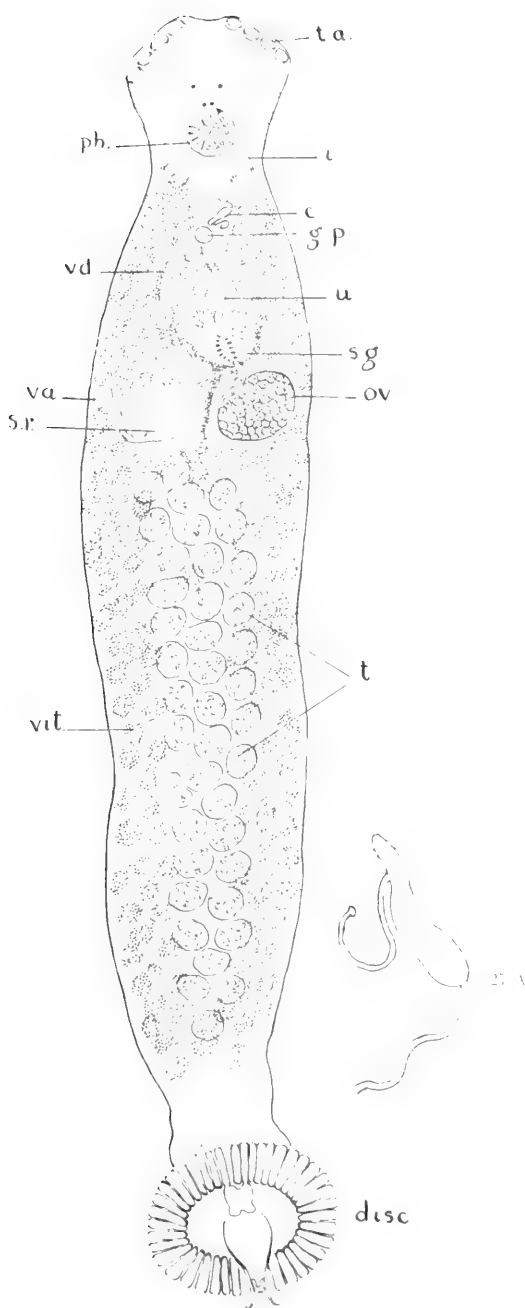


FIG. 27. *Platyhelminthes*. FIG. 27-A. CIRRIUS AND C. S. S. S.

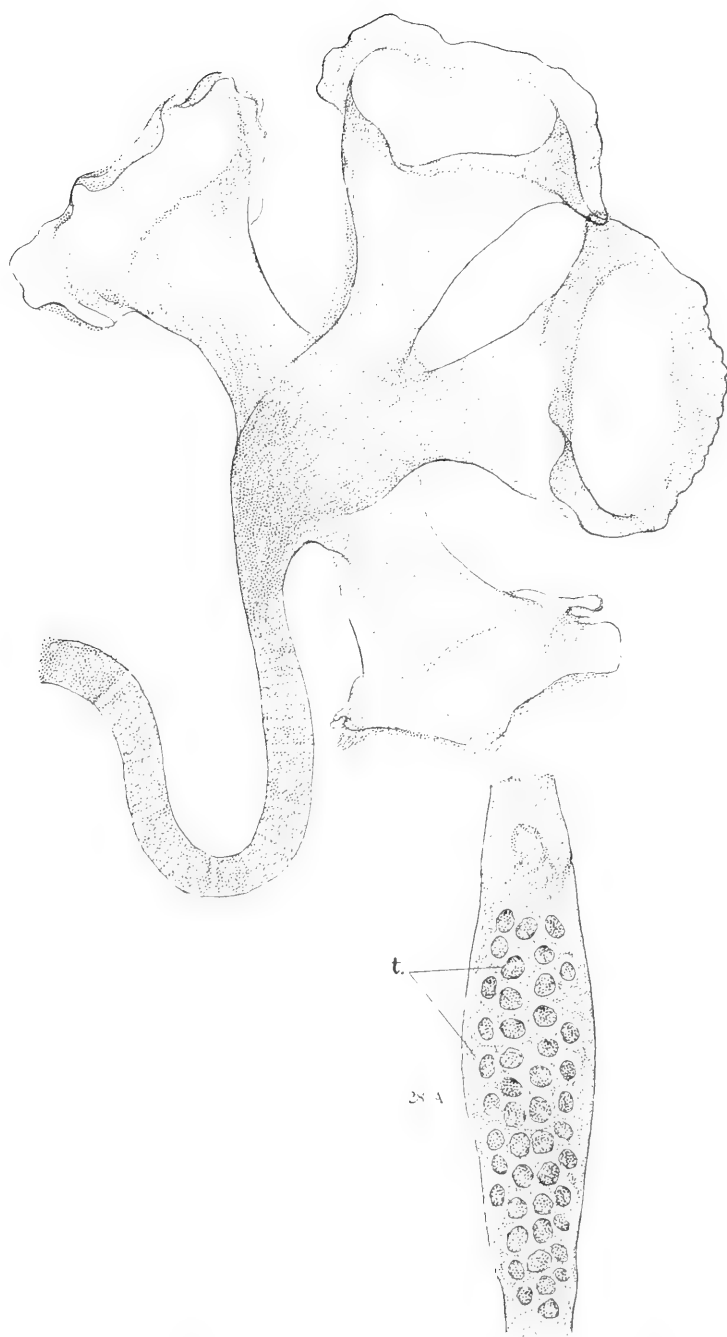


FIG. 28. *ANTHOBOTHRUM LILII-FORMIS*. FIG. 28-A. RIFE PROGLOTTID.

On looking into the pharynx anteriorly which in certain positions is quite possible, the mucous lining is seen to be arranged in longitudinal folds corresponding to the curves on the lips. There are four eyes, two of which appear to be always placed just within the margins of the pharynx. They are close together; the other two are further apart and are more anterior.

MACCALLUM, G. A.

1913—An abstract from *Centralblatt für Bakteriologie Parasitenkunde*, on *Acanthocotyle bothi*, n. sp. t. h. *Bothus maculatus*, pp. 407-410, figs. 3, 70 Band.

Anthobothrium lilliiformis, sp. nov.

(Fig. 28 and 28a)

Habitat—Spiral valve.

Host—*Dasybatus pastinacus*.

Locality—Woods Hole, Mass.

While working at the Laboratory of the United States Fish Commission at Woods Hole, on July 8, 1916, there were found in the contents of the spiral valve of a large sting ray (*Dasybatus pastinacus*), two specimens of a very small, but beautiful cestode. The head is in the form of a cluster of lilies on a small stem, almost exactly as would be the appearance of four flowers of a lily. They are deeply cup or trumpet shaped with the margins delicately crenulated. The bothria are exceedingly delicate, showing in structure many delicate muscular fibres radiating to the margins from the point of attachment to the stem. As will be seen from the measurements appended the whole head is small.

Van Beneden has described the finding of a somewhat similar form in some unidentified species of Ray and again later in *Galeus canis*, and named it *Anthobothrium cornucopia*. His illustration of the form, as given in Braun's *Cestoden*, apparently has four bothria of a delicate wineglass shape, but it gives the impression that they are firm and rather thick, while the edges too are smooth and comparatively thick—no segmentation of the strobila is shown, while in the present form, of which only 20 mm. were recovered, the segments begin very near the head. The bothria in the present worm are very delicate, and the margins are not thick or smooth, but exceedingly filmy and irregularly wavy. As Beneden's specimens were found in Europe, and in different fish and with variations and differences in its structure it would seem that *A. lilliiformis* should be described as a variety, if not a new species. If V. Beneden's illustration of the worms he desires to portray were more adequate in depicting the anatomy of the animals

he sketches one could be more certain what his pictures were meant to show.

The host of *Anthobothrium lilliiformis* is different from that of *V. Beneden's* worm, and the locality where found thousands of miles apart, which may account for the variations in form, etc.

Several ripe proglottids were found which are as sketched:

Measurements of *Anthobothrium lilliiformis*

Diameter across the head	2.00 mm.
Diameter across strobila at neck20 mm.
Length of ripe proglottid	2.20 mm.
Width of ripe proglottid40 mm.

Alcicornis carangis, gen. et sp. nov.

(Fig. 29)

Host—*Caranx ruber*, t. h.

Habitat—Intestines.

Locality—Aquarium of New York, brought from Key West, Florida.

In the intestine of a *Caranx ruber* there were found on May 4, 1916, in moderate numbers, a small worm whose characteristics are so unusual that a new genus must be established for its reception. The head is a most remarkable structure, since it is surrounded generally by from three to seven antler-like projections or tentacles, each tipped with a cilium. These tentacles are branched like the antlers of a deer, and their function can only be guessed at as no live specimens were seen, but perhaps they are used as sensory organs or feelers. No particular anatomical structure in them indicates their use. The mouth is presumably at the anterior end, at the base of and between the antlers, but it is not very distinct. It is followed by a wide oesophagus which is triangular in shape, gradually narrowing as it proceeds posteriorly to terminate in a single rather large intestine, which extends towards the posterior end of the worm. Thus it is seen that the alimentary tract is of the simplest. The neck is almost half the length of the worm, and in some specimens it is armed thickly with small spines almost as far back as the beginning of the body. This latter is about twice the width of the neck, and it also is covered sparsely with spines.

The genital arrangement is not easily made out—there are two comparatively large testes situated on one side of the body, and immediately in front of these is the irregularly shaped ovary, which is almost half the size of each testis. The vitellaria are very prominent, in the form of ten or twelve roundish lobules situated across the body in front of the ovary. The greater part of the body is occupied with coils of the uterus, filled with rather large yellowish eggs, and these with the vitellaria so cover in the structures in the abdomen that no

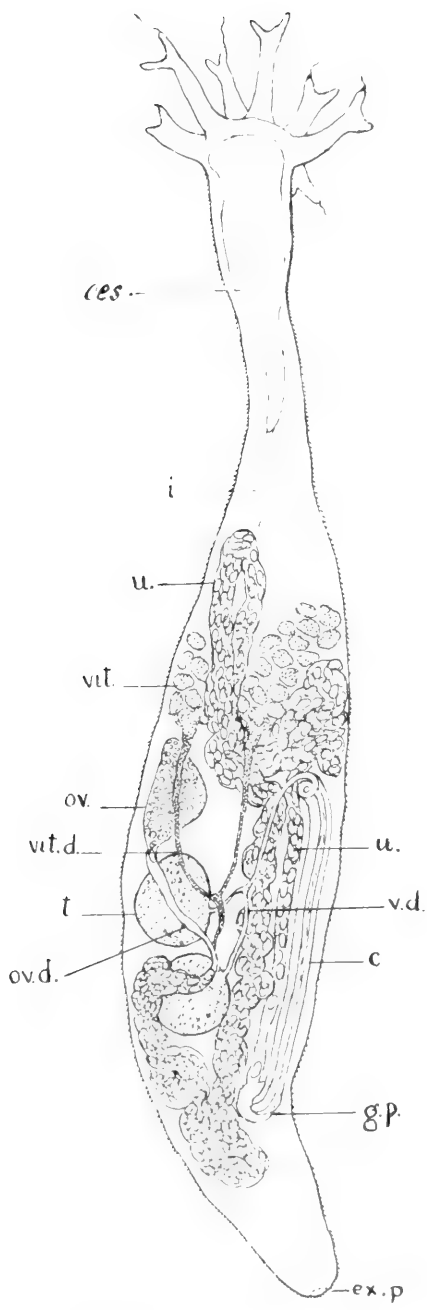


FIG. 29. H. HORN'S CIRRIIDS.

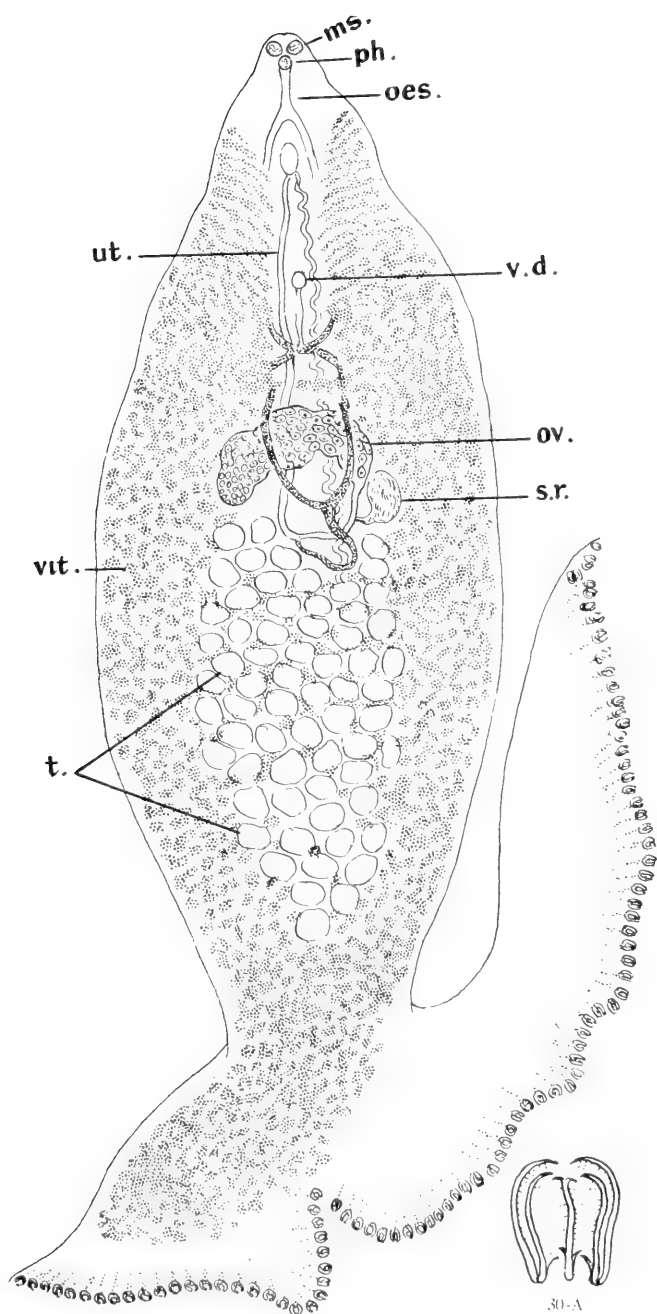


FIG. 30. *MICROCOTYLE INCOMPARABILIS*.

FIG. 30-A. DISC SUCKER, ENLARGED.

ventral sucker, vagina or seminal reservoir may be seen, indeed, on this account, the genital junction cannot be wholly made out. The testes are situated on the right side of the worm, and their efferent tubes unite to form the vas deferens which passes over to the left side and there, about the middle of the body, enters the cirrus sac which extends along the left side nearly to the posterior end, where is situated the genital pore. Here also the uterus finds its outlet. The excretory pore opens at the extreme end of the worm.

The host belongs to the same family as the pompano and although the parasites are numerous they are so small that it is unlikely that they were of much detriment to the fish.

For the purpose of classification this remarkable worm is characterized by the peculiar formation of its head, which is provided with relatively large branched tentacles, which are of the shape of deer's horns, each of said horns provided with a fairly long cilium. Neck forms one third of the length of the body. No pharynx, vagina or seminal reservoir seen.

Measurements of *Alcicornis carangis*

Length	2.50 mm.
Width20 mm.
Length of tentacles on head10 mm.
Width of tentacles on head02 mm.
Length of oesophagus60 mm.

Microcotyle incomparabilis, sp. nov.

(Fig. 30)

Host—*Caranx ruber*, t. h.

Habitat—Gills.

Locality—New York Aquarium, from Key West Florida.

While examining a *Caranx ruber* on May 4, 1916, five worms were found on the gills, which were so elegant in form and so unlike the ordinary *Microcotyle* that at first it was thought that a new axine had been found. However, not being sure that an axine is ever symmetrical in shape of body, the present worm must be classed with the *Microcotylidae*.

The worm is rather short, yet is of a graceful, long oval form, the head being very pointed, the two mouth suckers very near the tip. They are round in outline, the opening in each being an oblique slit, with the margins armed with small regularly placed spines; at the bottom of the suckers also are a few spines. Between the suckers is the pharynx, this is almost perfectly round and it is so near the tip, it must be the mouth as is so often the case in many trematodes. The oesophagus is rather short and soon divides into the ceca which extend

backwards on each side, under the vitellaria, an unknown distance. As usual well up in the angle of the ceca is the genital pore. A short distance posteriorly, about twice the length of the oesophagus, is seen the vaginal opening which, evidently is on the dorsal surface. It is surrounded by about twenty very small spines. The vitellaria are exceedingly plentiful and extend from about the division of the ceca throughout the body well into the caudal disc. The vitelline ducts are very large and distinct, and they leave the mass on each side nearly opposite the vaginal opening, but come together a few millimeters below, and there join the center and receive the vagina, they then separate again and proceeding backwards join again to form an irregular circle and the V-shaped reservoir which at its point empties into the oviduct. The ovary is somewhat like a horseshoe in shape extending across the body at about the junction of the middle two-thirds with the anterior third of the worm. The oviduct is given off on the left side, and is at first directed backwards; near its origin it receives the duct of the seminal reservoir, it then passes through the ootype and shell gland and merges into the uterus. No eggs were seen.

The testes are numerous, probably about seventy-five. They are much covered in by the vitellaria. The vas deferens is very tortuous in its course to the genital pore.

The clinging disc is the ornamental as well as useful organ of the worm. In most of the specimens two pairs of suckers lie side by side all the way round the edge of the disc, but in others apparently only one pair of suckers are placed at the edge. They are delicately as well as firmly attached to the disc by muscular strands which are all of an even size and placed at an equable distance from each other which adds to the beauty of the disc. The chitinous framework of the suckers is different in shape from those of most *Microcotyle*. They vary in number from 86 to 89 pairs. For shape of chitinous structure see Fig. 14.

Measurements of *Microcotyle incomparabilis*

Width of body	1.80 mm.
Length of body	5.00 mm.

Catoptroides magnum, sp. nov.

(Fig. 31)

Family—*Gorgoderidae*, Lss.

Genus—*Phyllodistomum*, Ben.

Host—*Balistes carolinensis*.

Habitat—Urinary bladder of marine fishes.

Locality—Aquarium at New York, from Key West, Florida.

Linton while working at the Dry Tortugas found a worm in a *Lactophrys triqueter*, trunk fish, which he described as having a spiny

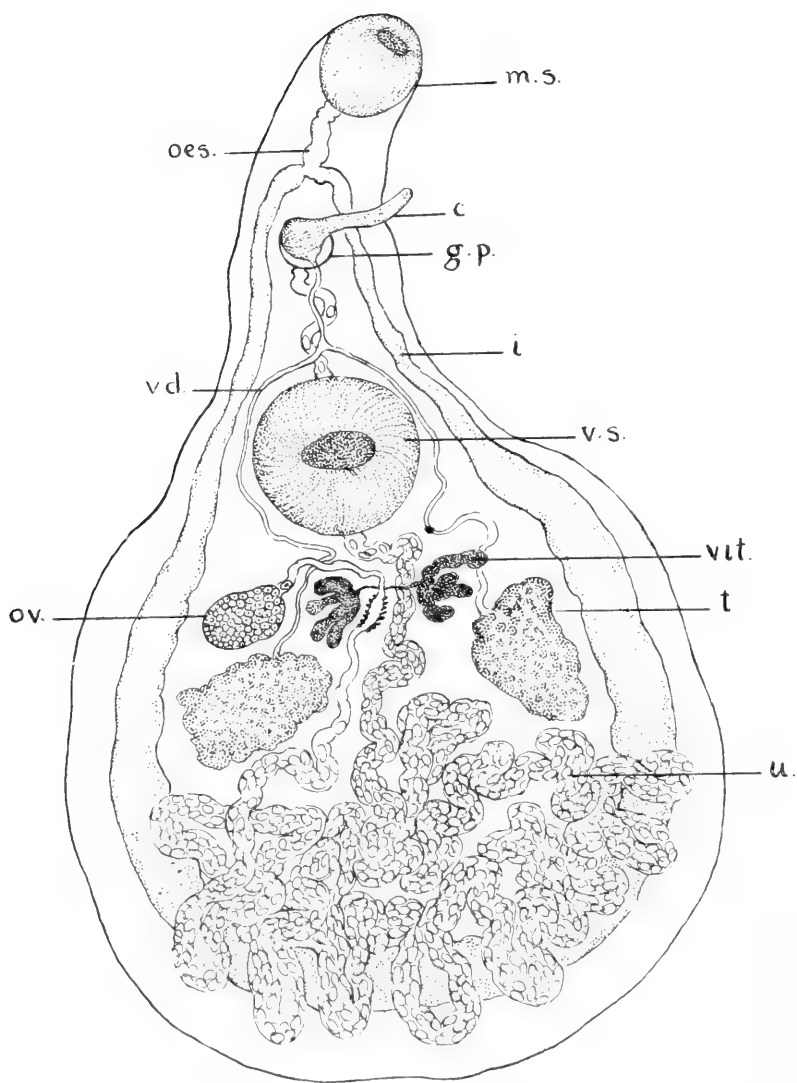


FIG. 31. *CATOPTROIDES MAGNUM*.

skin and spines in the suckers. He states also that the surface of the abdominal skin is ridged with transverse striae giving it the appearance of a rasp, and upon these characteristics he established a new genus *Xystretrum* with the species *papillosum*. He also described finding in a fish at Bermuda another single worm, which belonged, as he thought, to this genus, but inasmuch as the vitellaria were of a more compact character he regarded it as a different species and named it *X. solidum*. It had the same transverse striae on the abdominal surface and spines throughout. I too have met with this genus on one or two occasions. On May 31, 1915, there were found in the urinary bladder of *Balistes carolinensis*, trigger fish, one of these worms; and on April 13, 1916, in the urinary bladder of another *B. carolinensis* fourteen similar worms which do not answer the description of Linton's *Xystretrum papillosum* since they are larger, and have an entirely smooth thick spineless skin throughout.

The anterior sucker is subterminal and the mouth is near the centre of this. The pharynx, if present, is not apparent. The oesophagus is rather short and divides into the ceca almost at once. These are large and pass in a continuous circle about the posterior end of the worm. The genital pore is placed well up in the angle of the divided ceca, and here the cirrus may often be seen protruded and about .60 mm. in length. The ventral sucker is large, being about twice the size of the oral sucker. Almost immediately posterior to the ventral sucker are the vitellaria, small and irregularly finger shaped and clustered in two masses. Behind these are the two testes, and between the latter and the two masses of vitellaria is the genital junction, and also between the vitelline masses is the ootype, the eggs after passing through this pass posteriorly through the coils of the uterus and finally under the left edge of the ventral sucker on its way to the genital pore, which is central and anterior to the acetabulum. The ovary is small and situated anterior to the right testis. The testes are much larger than the ovary, and each sends its efferent duct forward on each side of the ventral sucker to join anterior to it before proceeding to the genital pore, and before terminating in the vas deferens and the cirrus. The uterus fills the posterior part of the body, and the eggs are relatively small, but numerous. On account of its relatively large size I would suggest the name *Catroptoides magnum*. For the purpose of classification it may be said to be of the shape of a flattened Flemish flask or tennis racquet, almost circular body and an elongated neck. The ventral sucker, which is large, and situated at the junction of the neck with the body, forms a prominent feature, skin thick and smooth. No spines anywhere, ceca continuous.

Measurements of *Catroptoides magnum*.

Whole length of worm	5.00 mm.
Width of body	3.40 mm.
Length of body alone	3.40 mm.

Length of neck	1.60 mm.
Width of neck at base	1.00 mm.
Width of mouth or oral sucker40 mm.
Diameter of ventral sucker	1.00 mm.
Length of protruded cirrus60 mm.

On referring to Prof. T. Odhner's Report of the Swedish Zoological Expedition to Egypt and the White Nile in 1901, I find that there were found a number of worms in the urinary bladder of fishes for instance *Bagrus bayad* and *B. docmac* and also in *Malapterurus electricus* (Omdurman), which were considered new and have been recorded under the genus name *Catoptroides*, Odhn. These worms undoubtedly belong to the same genus as those which Dr. Linton has called *Xystretrum*. They are undoubtedly of a different species, but the genus is the same. One, Odhner names *Catoptroides spatula* and another *C. spatulaeformis*, and claims for them that they form a new genus.

As Linton's paper is dated 1910, and Odhner's 1902 by the rule of priority the genus should be *Catoptroides* instead of *Xystretrum*.

Catoptroides aluterae, sp. nov.

Host—*Alutera schoepfii*, t. h.

Habitat—Urinary bladder.

Locality—New York Aquarium, from Key West, Fla.

On May 4, 1915, there were found in the urinary bladder of an *Alutera schoepfii* (Orange Filefish), forty-six small worms, which evidently belong to the genus *Catoptroides*, Odhn. They were very active when first liberated, but soon lost their vitality when placed in sea water. This worm is much smaller and more delicate in structure than *C. magnum*, and, like it, its skin is free from spines as well as the transverse striae which Linton credits *Xystretrum papillosum* with. When a number are mounted on a slide together it can be easily seen that the intestine is continuous around the posterior end of the body. It is also not an unusual thing to see the thin edge of the body folded under in some specimens, but this is not at all constant. On the whole, from these differences, it cannot be said to be the same as *C. magnum* or *Xystretrum papillosum*, and consequently will have to be called a new species.

Measurements of *Catoptroides aluterae*

Length	3.40 mm.
Width	2.60 mm.
Length of neck	1.20 mm.
Width of neck at base80 mm.
Width of mouth sucker20 mm.
Length of protruded cirrus40 mm.

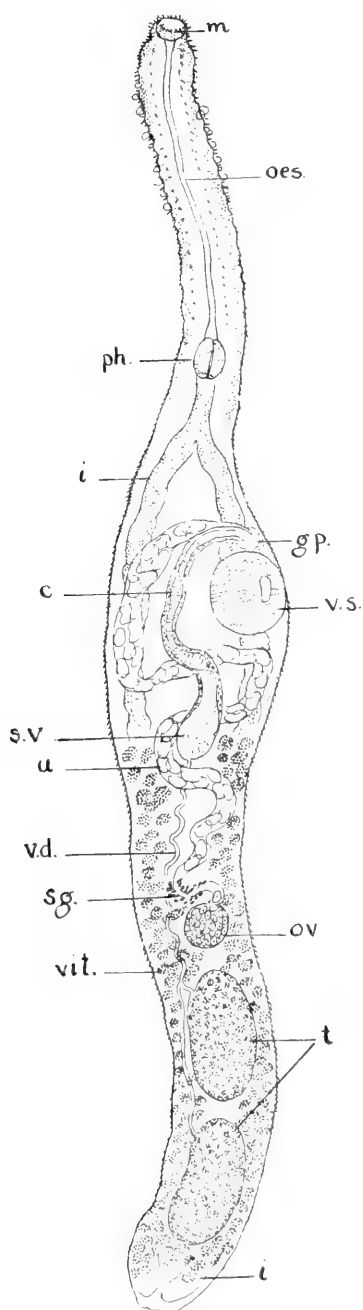


FIG. 32 STEPHINOCHASMUS ROBUSTUS

Stephanochasmus robustus, sp. nov.

(Fig. 32)

Sub-family—*Echinostominae*.Genus—*Stephanochasmus*.Host—*Leptocephalus conger*.

Habitat—Intestines.

Locality—New York Aquarium.

With thirteen of these worms mounted from the intestine of a *Leptocephalus conger*, which was confined and died in the New York Aquarium, October 30, 1915, it is possible to choose from many good specimens. None of them are so large apparently as *S. cesticillus*, Mol., as shown in any plate presently accessible, yet they are much larger than the members of the following group, viz:—

<i>S. valdeninflatus</i> , Stoss—length ..	2.50-3.00 mm.
<i>S. tenuis</i> —Linton	3.00 mm.
<i>S. tenuissimus</i> —Linton	3.15-4.5 mm.
<i>S. sobrinus</i> —Lev.	4.5 mm.
<i>S. dentatus</i> —L.	1.14-1.85 mm.
<i>S. casus</i> —L.	2.24-6.37 mm.
<i>S. sentus</i> —L.	3.64-3.78 mm.
<i>S. cesticillus</i> uncertain at present but suspect	12.00 mm.
<i>S. robustus</i> —Dr. G. A. MacCallum	7.50 mm.

As there are other peculiarities, one is forced to conclude that this is another species to be added to the above known list.

Many of the species are spiny throughout, others have but few spines, although generally two rows about the mouth. Even those about the mouth are very irregular in these specimens, also on the neck. There are on the neck of many of them a peculiar lot of little round pediculated papules filled with fluid and arranged in more or less regular transverse rows of four or five different sizes (Fig. 32), and beside these are the spines and numerous stumps of spines.

The neck is long and composes about one-third of the length of the worm. It is cylindrical and extends from the mouth to beyond the division of the ceca. The mouth is terminal, or nearly so, and is surrounded on the lips by very prominent spines in broken up rows.

Immediately below the mouth on each side is a prominence or shoulder, which is present in almost every case, following a sort of neck. The oesophagus extends to the rather square-shaped pharynx which is placed two-thirds of the way down the neck, and is followed by a rather short post pharyngeal oesophagus, which divides into the ceca just before the neck reaches the body. Almost at the middle and situated on the left side of the body is the large acetabulum, and immediately in front of it is the genital cloaca. Where the uterus and

cirrus terminate. The cirrus is long, showing well the unusually muscular prostatic portion. The whole is enclosed in a large cirrus sac. The testes, two in number, are relatively very large—the posterior one usually the larger, and the vasa efferentia join in front of the anterior testis to form the vas deferens. This is an unusual structure and the cirrus appears to have spines at its end. The ovary is not more than one-fifth or sixth the size of each testis. These latter are situated one before the other, near the posterior end of the body, and the ovary is immediately in front of these, and gives off its oviduct anteriorly where the genital junction may be seen of the vitelline ducts, the shell gland and the duct form the seminal reservoir.

The uterus is not very large nor are the eggs many, but they are relatively large. The vitellaria are not very profuse. The water vascular system can be followed in places, and is seen to terminate at the extreme end of the body.

Measurements of *Stephanochasmus robustus*.

Length	7.50 mm.
Width80 mm.
Testes80 x .40 mm

Microcotyle polynemi, sp. nov.

(Figs. 33 and 33a)

Host—*Polynemus auratus*, t. h.

Habitat—Gills.

Locality—Batavia, Java.

On May 22, 1916, there were found on the gills of *Polynemus auratus* several *Microcotyle* of peculiar formation. The fish was obtained in the market at Batavia, Java, and is one of the common food fishes there. Apparently the fish was not as badly infested with the parasites as is the case often with other fishes, yet several good specimens were found by Dr. W. G. MacCallum, who collected them.

The worm is of elongated form although about half of its length is composed of its sucker disc, which is peculiar in shape being composed of two rows of claspers or suckers, set very closely together which make the disc narrow. There are on the two sides about one hundred and seventy-five clasps, which are in shape very much like those of other members of this family.

The head is wide and has on either side a rather large sucker which is placed obliquely towards the mouth, and along the edges of their openings are minute spines or small hooks. The mouth is almost terminal and on a small lip or protuberance in the center is a cluster of small hooks or spines, also at each side of the head is a similar cluster.

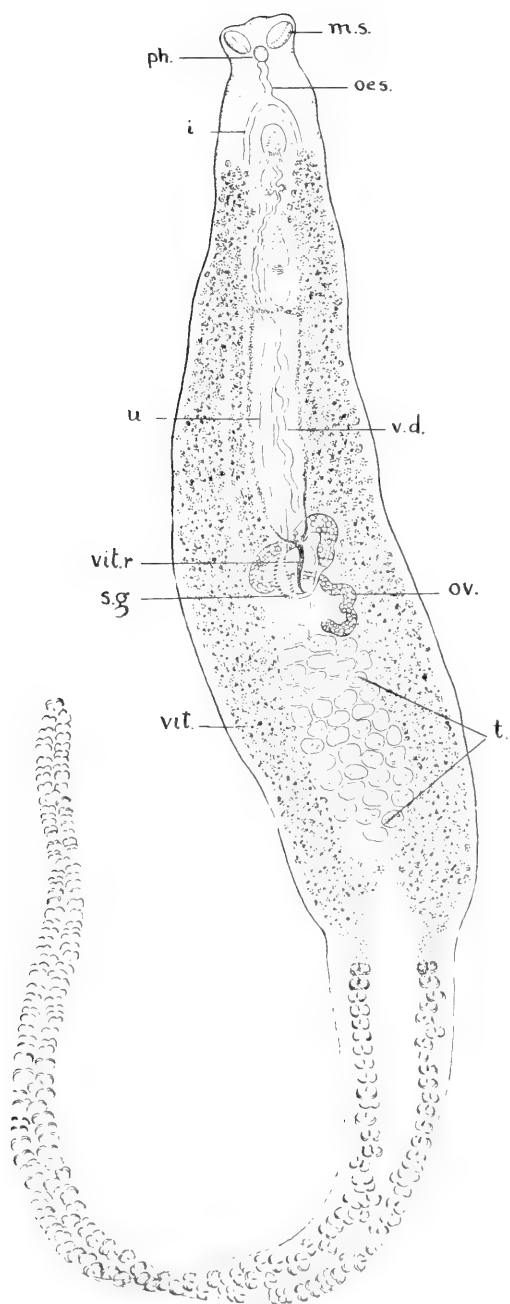


FIG. 33. MICROCTYLE POLYNEMI.

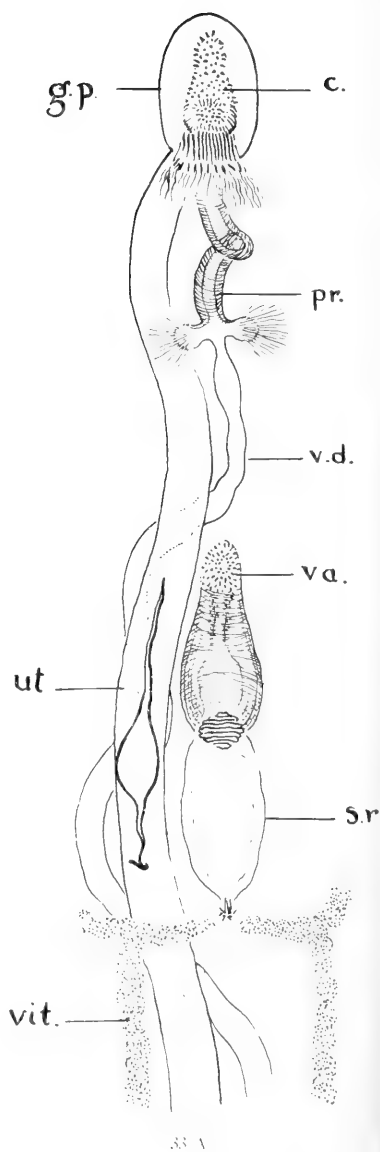


FIG. 33-A. GENITAL SCHEME.

The suckers have not only a row of spines along the edges of their opening, but inside of the inner side of the opening the spines are in three or four rows and spines are also seen in the bottom of each sucker. The head is marked off from the body by a decided neck.

Between the suckers and close to them is the pharynx, which probably answers the place of an auxiliary mouth. The oesophagus is not long and divides into the ceca as usual, and up in the angle of division is placed the peculiar cloaca occupying a relatively large area, and has lying longitudinally in it a large and very spinous cirrus.

The genital pore itself is armed or ornamented with a great number of spines of varying length arranged in a very artistic manner for a considerable distance around, and making its tortuous way to the opening may be seen the convoluted vas deferens, terminating here with a peculiar cirrus. The prostatic portion is an unusually muscular structure. The vaginal opening appears about one-quarter the length of the body from the head, and this, too, is much armed with spines different from that of other members of this family. The edges of its opening display a number of carunculae around its edge, it at once widens into a relatively large muscular sac with circular fibres in its walls. It narrows to a point where it evidently has a strong sphincter, then it widens again into a considerable sac which at its posterior end empties into the junction of the vitelline ducts and at this point is a cluster of spines. No seminal reservoir is seen elsewhere so that one is forced to consider the possibility of this sac at the end of the vagina as the seminal reservoir, however unusual the location may appear to be. The vitellaria are exceedingly profuse and the ducts which go to form the reservoir form a sort of parallelogram before concentrating to join the oviduct. The ovary is a large coiling structure placed across the worm about its middle, giving off the oviduct at its anterior end. The ootype is wide and the shell gland is large, it is generally very distinctly seen and nearly always filled with yolk material, in one case this material is moulded into egg shape, and is partly covered with chitinous material in process of completion before being forced on into the uterus.

An egg appears in the uterus of one specimen. It is oval, yellow and provided with a filament at either pole, that attached to the posterior pole is provided with double hook like an anchor. There are about forty testes.

Measurements of *Microcotyle polynemi*

Length	10.00 mm.
Width	1.00 mm.
Width of head40 mm.
Width of disc40 mm.

Cithara priacanthi, gen. et. sp. nov.

(Fig. 34)

Hosts—*Priacanthus cruentatus*, *Sclepe vomer*, *Caranx ruber*.

Habitat—Intestines.

Locality—Key West, Florida and New York Aquarium.

On May 31, 1915, two large *Priacanthus cruentatus*, or glasseye snappers were examined, and in the intestines of one an unusual worm was found. It was solitary, and afterwards, on May 4, 1916, another solitary specimen was found in the intestine of *Caranx ruber* which was exactly like the former one.

The body is long and narrow, rather pointed posteriorly where the excretory pore is to be seen. In the centre of the body is a relatively very large ventral sucker. It is situated to the left side, and more than half fills up the width of the body cavity.

The head and neck, are, however, the most conspicuous features of the worm. The head is almost of an exact oval shape, and around its middle is a circle of relatively large tentacles about twenty in number. These point backwards, and are striated across. The head in front of these tentacles is marked on its surface with linear striae, which make it appear almost as if covered with hair. These lines, however, which extend principally downwards, outwards and backwards are merely on the surface. The mouth is terminal, and from it a large prepharyngeal oesophagus extends to the pharynx behind. This is unusually large, nearly as long as the head, and, as usual, is marked with muscular striae, which meet in the middle longitudinal line. The pharynx is followed by a long oesophagus, which divides near the end of the neck and in the angle of the intestines is situated the genital cloaca in front and to the left side of the ventral sucker. One peculiar feature about the neck is the presence on the ventral surface of the anterior half of six short straps on each side which extend from the oesophagus to a little external to the margin of the neck. They are of an equal size and are placed equidistant from each other.

The two testes are one before the other near the posterior end of the body. The cirrus in the cirrus sac is large and long, and proceeds to the genital pore to the right of the acetabulum. The uterus is voluminous and accompanies the cirrus in the last portion of its course to the cloaca.

The ovary is as large as either testis, and is situated in advance of the testes and at the junction of the posterior third with the anterior two-thirds of the body and on the left side. The vitellaria are not very plentiful, being composed of a few nodules about the middle of the sides of the worm. The intestines extend to almost the extreme posterior end of the body. The eggs are fairly large and are plentiful.

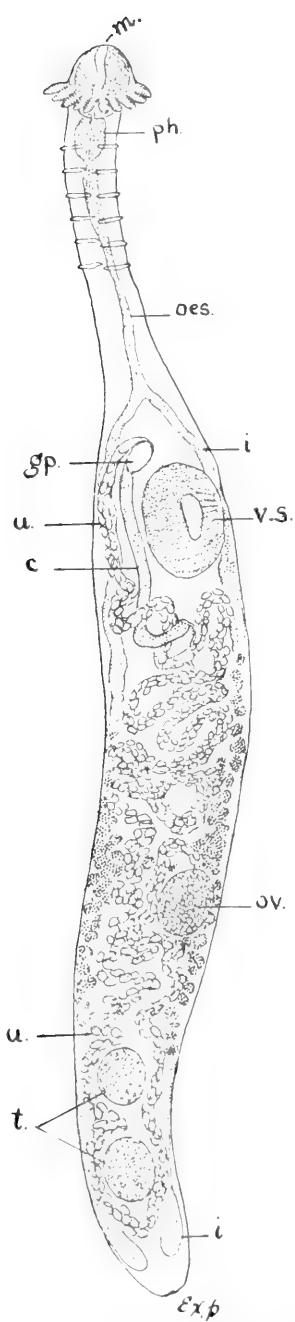


FIG. 34. *CITILIRA PRIGINTHIL*.

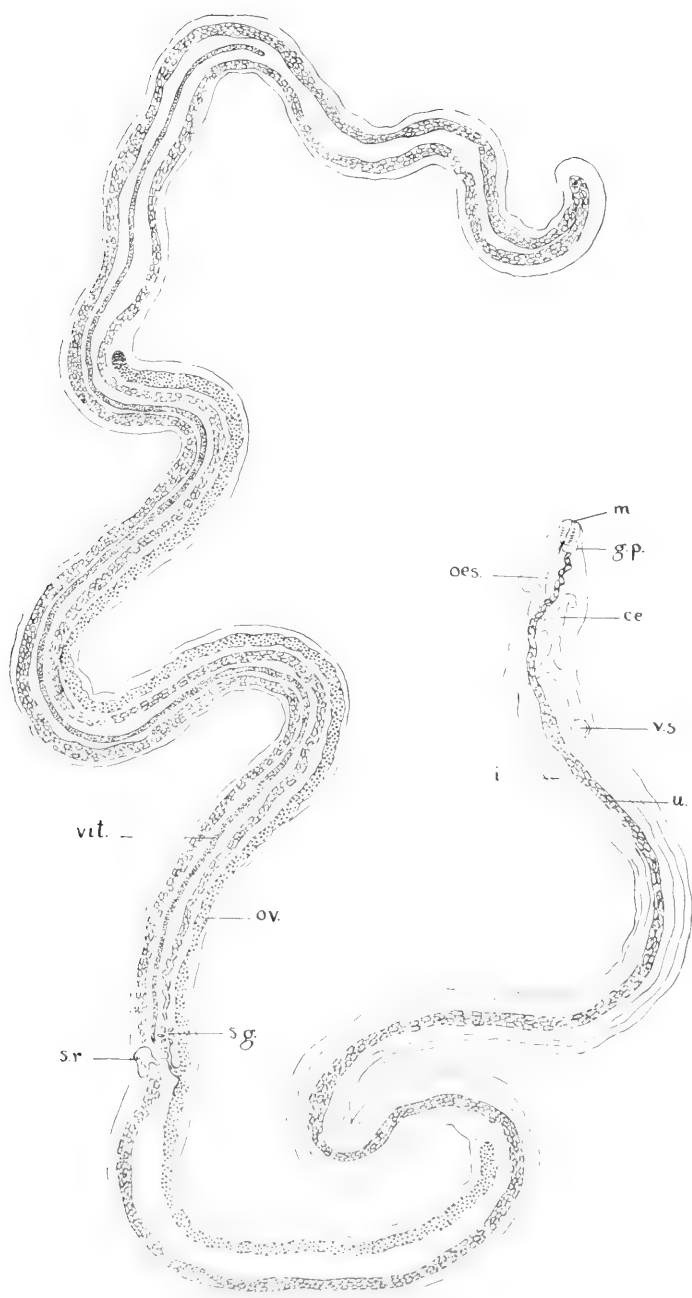


FIG. 88. ALAIOSTROPHION EPINEPHELI.

The uterus fills most of the body cavity. Genital junction not made out owing to being obscured by the folds of the uterus.

Measurements of *Cithara priacanthi*, gen. et. sp. nov.

Length	5.00 mm.
Width (widest part)60 mm.
Diameter of acetabulum40 mm.
Width of head20 mm.
Length of head25 mm.
Length of tentacles060 mm.

Atalostrophion epinepheli, sp. nov.

(Fig. 35)

Host—*Epinephelus striatus*, t. h.

Habitat—Branchial cavity and neighborhood.

Locality—New York Aquarium, originally from Bermuda.

Another member of this odd genus which must be recorded was found under the mucous membrane in the branchial cavity of an *Epinephelus striatus*, Nassau grouper on March 20, 1916. The host was kindly sent me by Dr. Townsend, the Director of the New York Aquarium. The first member of this genus to attract attention was found in the gill cavity of a *Sarda sarda* at Woods Hole, Mass., and after a great deal of trouble and weeks of work a whole worm was secured. Although hundreds could be seen matted together under the mucous membrane and in the tissues especially of the isthmus, it was so delicate and so fragile that almost invariably the piece secured was found to be broken at both ends. An account of it was published in *Zoologica* by the New York Zoological Society in Vol. I, Number 20, "Some New Species of Ectoparasitic Trematodes," June, 1915. Another species of the same genus was found at the New York Aquarium in the gill cavity of a *Promicrops guttatus*. The present worm, however, differs in some important particulars from the above members of the family, so much so in fact, that it must be called a new species. Like the other members of this family it is very much elongated, always found in, or near the gill cavity, and its natural habitat under the mucous membrane of that region.

It has a habit of partially leaving its place of abode and allowing itself to sway about in the water, in which way it becomes entangled in the gill filaments. Portions of the worm were frequently found clinging to the gills, where it was first observed and no doubt the portions of the body containing the uterus filled with eggs are often set free in the water and ingested by another unknown host.

The present worm, when examined closely after being stained, is found to be very much elongated with all of the principal organs tubular. Its length, when fully adult, is unknown, like the other members of the family, but one specimen was separated from the others which proved to be perfect, although young, still its uterus was partially filled with eggs which were oblong, yellow and without a filament. One of the important differences between this and *A. sardae* and *A. promicrops* is that it possesses an acetabulum like the distomes, which the others do not. This is situated posterior to the division of the intestines, a short distance from the head, and a considerable distance, probably one-third the length of the worm, in front of the genital junction. The other main feature of difference is that the oesophagus has a fairly large cecum on each side which curls backwards, but with what function these are endowed is unknown. The genital pore opens dorsal to the mouth, which is subterminal. The head is quite triangular or conical. No pharynx is seen, but the oesophagus is of considerable length before its division into the intestinal ceca, and it is midway of its length that the lateral ceca are given off. The ovary is long and much coiled which tends to give it a knobby appearance. It extends throughout a little more than one-third the length of the body and it gives off the oviduct at a point about the junction of its anterior third with its posterior two-thirds, and at this point it receives the duct from the seminal reservoir, and also that from the vitellaria. The testis is also tubular and extends about one-third the length of the worm. It is not shown in the plate. From here, too, the oviduct passes through the shell gland and merges into the uterus which proceeds to the extreme posterior end of the body, where it turns, doubling upon itself to make its way to the mouth behind, which it opens. The vitellaria, also tubular, extends from the oviduct almost to the posterior end of the worm. The intestines extend to very near the end of the body.

The specimen from which this description is given is only about 30 mm. long and .60 mm. wide, still fragments of other specimens more developed were found 60 mm. long, so that it is difficult to say really what length may be attained by an adult. They appear always to be of the same width.

There seems to be a good deal of confusion as to the classification of the members of this family, and there are those who regret that some definite understanding is not arrived at by parasitologists as to the close relation, which undoubtedly exists among the members of the species or families, and to unite upon some name, which will be acceptable to all. To show the diversity of ideas with reference to this group of worms, Looss classes *Köllikeria* in the family *Schistosomidae*, Monticelli gives a family *Didymozoonidae* with genera *Didymozoon* and *Nematobothrium*, Taschenberg speaks of a *Didymozoon* and Pratt in his classification gives it under the family *Didymozoonidae*, while Cobbold discusses it under the name *Köllikeria* and Odhner under the name *Wedlia*. The determination of the systematic position of the two worms

which we have named *Atalostrophion* involves the same difficulties as were met with in the case of these which make up the family *Didymozoidae*. A discussion of those forms was published some time ago in the *Zoologische Jahrbücher*, and there the conclusion was reached that since the names *Köllikeria* and *Wedlia* given by Cobbold for worms obviously corresponding with those later named by Taschenberg, *Didymozoon*, antedated by many years the latter name, one of them should be adopted. We adopted *Köllikeria* since it was the first in Cobbold's paper. Since that time, Odhner's paper, dated 1907, has come to our attention, unfortunately so late that it was impossible to do more than add a note recognizing his work and his priority of discussion. He apparently felt the same difficulties of nomenclature and adopts the generic term *Wedlia* for the form previously known as *monostomum bipartitum* retaining the name *Didymozoon* for *D. scombri*, in which the dissociation of the sexes is scarcely apparent, the worm living in varying numbers in cysts.

Cobbold's descriptions are so incomplete that either *Köllikeria* or *Wedlia* might represent the forms later described as *Didymozoon*. While recognizing Odhner's choice of *Wedlia* to describe one form, it seems that the ultimate clarity of the conception would be best served by retaining one of these names to designate all those forms in which there is a small elongate male and a larger lobulated female with narrow anterior extremity living together in a cyst.

Of Cobbold's descriptions *Köllikeria* fits that idea precisely, while *Wedlia* does not correspond so exactly inasmuch as it fails to describe the small male form, which by Odhner's own description, undoubtedly exists. Further Odhner retains the name *Didymozoon* to designate a form in which the two worms have similar elongate forms and show the organs of both sexes well developed. We therefore, prefer to adhere to our previous suggestion that *Köllikeria* be the name applied to those worms of different form living together in a cyst, with predominant female characters in one and male characters in the other. The present genus *Atalostrophion* differs, inasmuch as it is an elongated ribbon-like worm perfectly hermaphrodite with or without acetabulum and living in masses loose in the tissues and not encysted.

We therefore suggest the following classification:

Family *Didymozoidae*.

I. Genus *Köllikeria* (Cobbold, 1860).

Digenetic trematodes living in pairs in cysts. Hermaphrodite but sexually distinguishable by the outer form and by the predominance in each of the genital organs of one sex with obsolescence of the others. Anterior part of body narrow, posterior part cylindrical or swollen into kidney shape: sometimes two individuals are grown together. Suckers rudimentary or feebly developed. Both may be present or one or both may be absent. Pharynx and intestine may be rudimentary or

absent. Genital opening near the mouth. Ovary and yolk gland long convoluted tubes, meeting in a shell gland at beginning of long tubular uterus. Eggs yellow and rounded. Testes saccular or tubular with long convoluted vas deferens. No muscular cirrus. Many forms are supplied with a nutritive vascular film for the host.

2. Genus *Nematobothrium* (Van Beneden, 1858).

Trematodes of greatly elongated form living in the mature state in pairs in cysts in the gills or flesh of fishes. Digestive tract in various degrees of retrogression. Hermaphrodite, but tending to the retrogression of one sex in each. Genital opening directly behind the mouth at the cephalic extremity. Ovary and vitellaria in the form of long coiled cords. Shell gland and seminal reservoirs well developed, uterus forming extremely long coiled tube. Single testis, and vas deferens, rudimentary penis.

3. Genus *Atalostrophion* (G. A. MacCallum, 1916).

Extremely elongate delicate band-like worms, living in tangled masses under the mucous membrane of the branchial cavities of fishes. Digestive tract well developed and bifurcated. Acetabulum sometimes present. Hermaphrodite both sets of organs being well developed. Genital pore near the mouth. Ovary and testes tubular. Shell gland and seminal reservoir well developed. Vitellaria long and tubular.

Rhynchobothrium microbothrium, sp. nov.

(Fig. 36)

Hosts—*Neomaenis analis* and *Neomaenis aya*, t. h.

Habitat—Thyroid gland.

Locality—New York Aquarium, (Key West).

On June 22, 1916, there were found encysted on the thyroid gland of a large *Neomaenis analis*, mutton fish, three *Rhynchobothria*, which hitherto do not seem to have been recognized or recorded. The cysts are large in proportion to the size of the interned worm, which is always surrounded by a mass of yellow cheesy material outside of its blastocyst. The cysts seem quite common for this location in this host, although in each fish there are not usually not more than three or four cysts, generally only one. The worm is in general structure like those of the genus, but with some difference sufficient to at least warrant its being recorded.

On first looking at the worms one is at once struck with the unusual bothria, which form only a narrow rim about the head, instead of the long bothria usual; this rim flows outward and upward at its

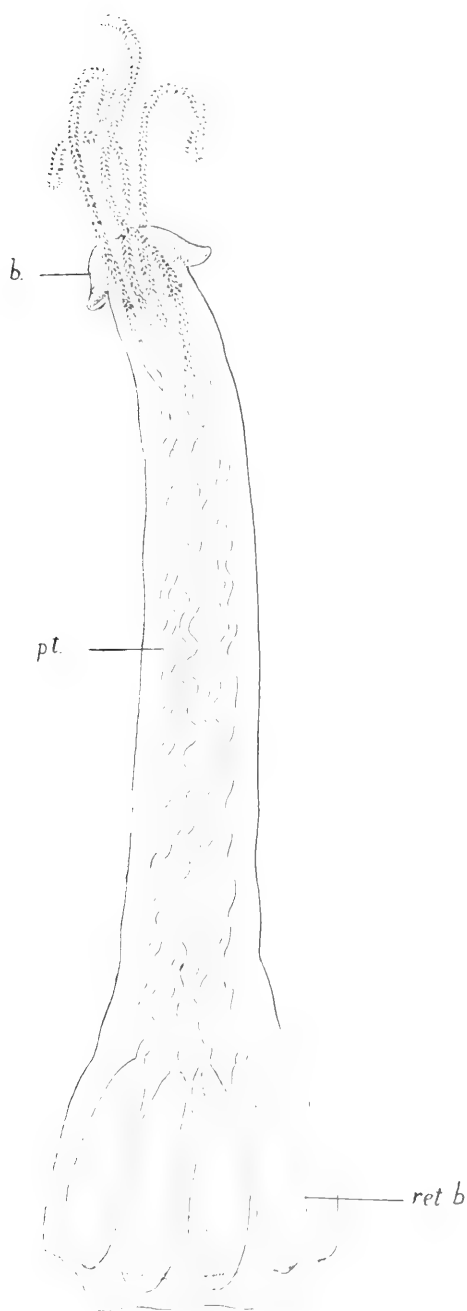


FIG. 36. *RHYNCHOBOTHRUM MICROBOTHRUM*.

posterior margin, but when closed looks like a shallow cap. There are only two bothria, one on each side, but each is partially divided by a groove, and from these, since they surround the outlet of the proboscides, these latter seem to spring. The proboscides are only moderately long and are covered with strong hooks of which there appear to be four rows, with smaller and straighter hooks scattered thickly over the inter spaces, those on the inside of the core are much the largest and strongest. The hooks in the four chief rows seem to be much more curved or hooked than those in the intervening spaces, which, after the bend, are apparently quite straight. In all the mounts which I have, the proboscides are flattened instead of round as usual and the central row of hooks are attached to a more highly stained base than those on the sides. This may be a fault in the technique which does not occur in my other mounts of *Rhynchobothria*. The proboscides are not half the length of the receiving tubes, which start from large muscular retracting bulbs.

It is understood, of course, that this form is only a larva or one stage in its existence. The next step in its development involves necessarily that it, and its present host must be eaten by its final host, some large fish. Then its cyst walls are digested and it is let free, when by means of its proboscidae it fastens itself in the mucous membrane of some part of the intestine from which it is suspended until the rest of its body, the strobila, is developed into a structure resembling the strobila of a tenia, the segments or proglottids of which are, when fully developed, thrown off to be taken in as food, probably by some small fish, which is in turn eaten by a *Neomacnis analis* or *Aya* and the cycle begins again.

Measurements of *Rhynchobothrium microbothrium*

Length of body	8.20 mm.
Width of posterior end of body	1.80 mm.
Width of head across bothria60 mm.
Length of unstretched tube	5.00 mm.
Length of withdrawn proboscis	3.00 mm.

ZOOPATHOLOGICA

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ON THE DISEASES OF ANIMALS



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NOTES ON THE GENUS TELORCHIS AND OTHER TREMATODES

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Thanks are also due to Dr. W. G. MacCallum for several unique and new forms collected by him during his trip to the Orient.

• Mr. A. Feinberg, artist, is also deserving of my sincere thanks for his patience and skill in preparing the plates.

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ABBREVIATIONS

Abbreviations in explanation of plates:

a.—anus	o.s.—oral sucker
b.c.—buccal sucker	ov.—ovary
b.—bursa	oot.—ootype
b.e.j.—bulbus ejaculatorius	oe.—oesophagus
c.s.—caudal sucker	ov.d.—oviduct
c.s.—cirrus sac	oes.g.—oesophageal gland
c.p.—cirrus pouch	ph.—pharynx
cl.—cloaca or genital pore	p.p.—pars prostatica
ce.—coeca.	pr.—prostate
cor.—coronet	p.—papillae post and preanal
c.—cirrus	res.—reservoir
c.gl.—cement glands	s.g.—shell gland
d.e.j.—Ductus ejaculatorius	s.v.—seminal vesicle or vesicula seminalis
e.—eye	s.r.—seminal reservoir
ex.p.—excretory pore	sp.—spicule
ex.v.—excretory vessels	t.—testis
g.i.c.—genito intestinal canal	tr.—tridents
g.p.—genital pore	u.—uterus
h.—hook.	u.g.—unicellular glands
i.—intestine	v.d.—vas deferens
li.—ligament	va.—vagina
le.—lemnisci	vit.—vitellaria
l.c.—Laurers canal	vit.d.—vitelline duct
m.—mouth	v.s.—ventral sucker or acetabulum
m.b.—muscular bands	w.v.s.—water vascular system
m.g.—mucus glands	y.d.—yolk duct
met.—metraterm	y.r.—yolk reservoir

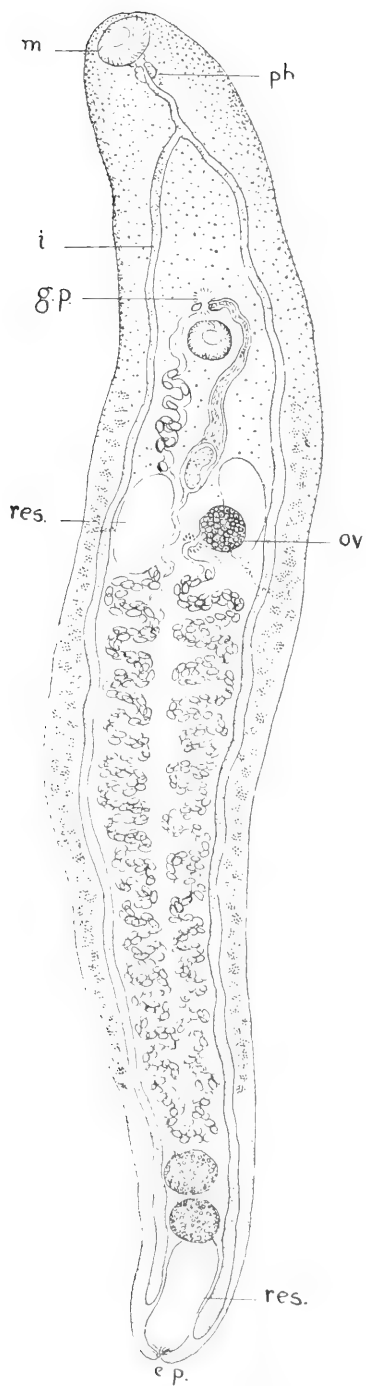


FIG. 57. *HETERORCHIS INSCULPTA*.

NOTES ON THE GENUS TELORCHIS AND OTHER TREMATODES

Telorchis insculpti, sp. nov.

(Fig. 37)

Host—*Chelopus insculptus*.

Habitat—Intestines.

Locality—Zoological Park, New York. Eastern U. S.

Stunkard in the Journal of Parasitology, Urbana, Ill., December 15, Vol. 2, pp. 57-66 in his paper on the Trematode genus *Telorchis*, has very ably described the origin of the name by Luche, 1889 (1899 Stiles and Hassall), and has given a fairly good general description of the anatomical structure of the genus with the variations noted in the various species. Perhaps in excessive detail, but nevertheless, such may be necessary on occasion. *T. insculpti* was found with others in the intestine of a wood turtle, *Chelopus insculptus* on January 4, 1918. It is a remarkably delicate formation, far more so than the plate shows. It is from 4 mm. to 5 mm. in length by .80 mm. in width.

It is wider at the head than at the posterior end, and for the anterior third of its length the skin is spiny, very much so at the head. In fact, the mouth is covered with spines both inside and without. The mouth sucker is 22μ wide and 12μ long. The mouth proper has its lips nearly touching and is only 12μ from side to side, while the anterior and posterior lips are only 7μ apart, and spines may be seen far back in the mouth. At the junction of the mouth sucker with the pharynx is a square portion which intervenes between these two structures. This is unusual and prevents the presence of a prepharyngeal oesophagus. It is 3μ from before backwards and is 10μ from side to side, is wider than the pharynx and shows at each end an apparent coecum or recess. The pharynx is 10μ wide and 8μ deep with the mouth lobulated. The oesophagus is 15μ long before bifurcation. From the bifurcation of the coeca to genital pore is 45μ . The pore is very spiny about its margin. The intestines are very narrow throughout. The acetabulum is 15μ in diameter. The cirrus sac is long, being 120μ and 15μ wide. There is on each side of the ovary a comparatively large water vascular reservoir, oval in shape, one 60μ long and 15μ wide, and the other 40μ and 20μ . At the posterior end, behind the testis, is another reservoir which is 45μ and 25μ . The ovary is round, situated about the middle of the worm at the end of the cirrus sac. It is 25μ in diameter. The testes are 25μ in diameter, more or less

circular in shape. The vitellaria extend from the genital pore on each side to within 40μ of the anterior margin of the anterior testis. It is arranged in delicate clumps in somewhat the shape of an expanded hand, but not properly shown in the plate. The uterus is in two columns, quite apart throughout, but they sometimes overlap the coeca. These latter extend almost to the posterior end. Eggs, 3μ wide and 5μ long. On each side of the pharynx is a cluster of unicellular glands.

Tclorchis pallidus, sp. nov.

(Fig. 38)

Host—*Chelopus insculptus*.

Habitat—Intestine.

Locality—New York Aquarium.

This worm was found on January 4, 1917, in a wood turtle along with some others of the same family, two good specimens being recovered. It is, however, so different from the others in structure, that it must be recorded as a new species. It is comparatively long, unarmed with spines on its skin, and very slender, being 7 mm. long and 55μ in width, and it is almost diaphanous, so delicate is it in structure. Its anatomy is somewhat different also. The mouth sucker is subterminal and rather oblong, being 20μ long and 15μ wide. The pharynx, 10μ long and 10μ wide, prepharyngeal oesophagus 10μ long, genital pore from division of coeca is 100μ . Length of cirrus and cirrus sac 135μ long, very narrow and extends almost to the ovary, which is situated about the middle of the body, both as regards the length and width. The ovary is round, and the genital junction is very distinct, a short distance posterior and to the left. This structure is not any different from usual, the oviduct is given off about the middle of the left side and proceeds backwards, and receives a delicate vitelline duct from each side. The ootype and shell gland are comparatively large. The seminal reservoir is situated on the right side of the genital junction. The uterus, full of eggs, extends from here posteriorly nearly to the anterior testis, and is bounded on each side by the intestines. These latter terminate very near the posterior end of the worm in quite widened coeca, and enclose or overlay a fairly large reservoir of the water vascular system. The testes are very small, being but a little larger than the ovary. The posterior one is 60μ from the end of the worm and the anterior one is 20μ in advance of its mate. The vitellaria are exceedingly sparse, being just a few small glands on each side, chiefly between a point opposite the ovary and 100μ further posteriorly. The glands are small and much scattered. There are two oval reservoirs, one on each side opposite the middle of the cirrus sac, the one the right being about twice the size of the left one.

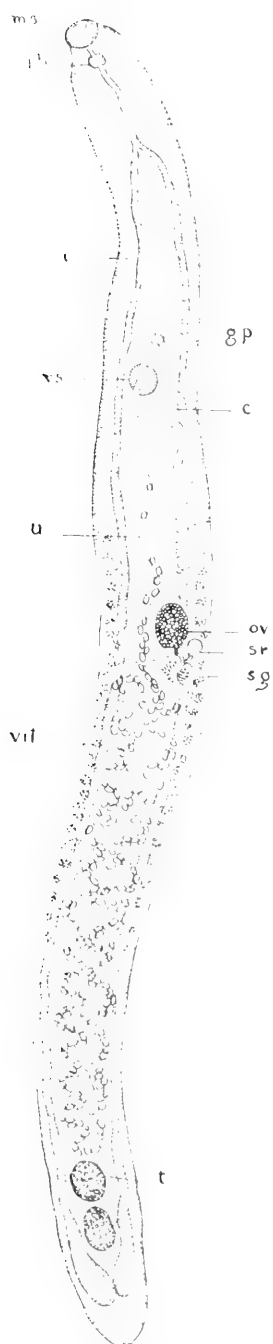


FIG. 38. *HETERAKIS PECTUS*

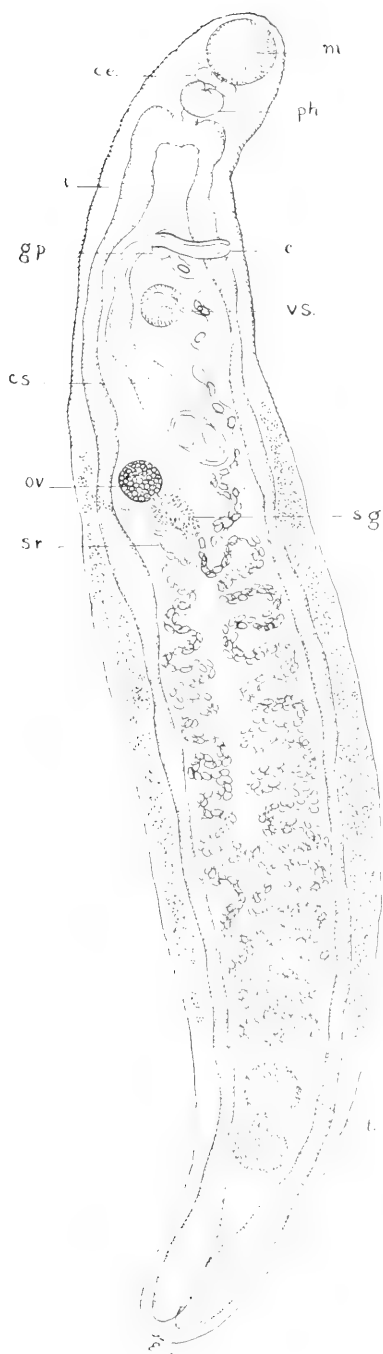


FIG. 39. *TEFORCHIS CHITLOI*.

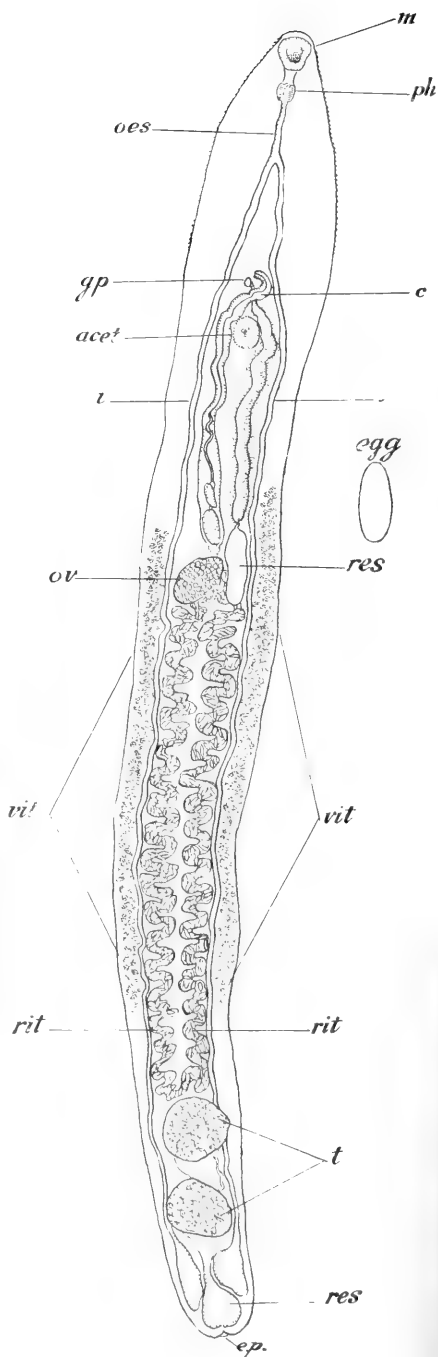


FIG. 40. *TEFORCHIS GUTTAHL*.

Telorchis chelopi, sp. nov.

(Fig. 39)

Host—*Chelopus inculptus*.

Habitat—Intestines.

Locality—New York Aquarium.

This worm was found with a number of others in the intestine of a wood turtle, *Chelopus inculptus* on January 4, 1918. It is a large coarse looking worm compared with some others of the same genus. The mouth sucker is 45μ across and 40μ deep. The anterior edge of the sucker is cut off square or deeply notched, and the posterior margin is separated from the pharynx by an oblong structure 25μ from side to side and about 5μ from before backwards. The outer ends of this structure seems to have a coecum at each end, and outside on each side is a mass of deeply staining unicellular glands. There is consequently no prepharyngeal oesophagus. The pharynx is roundish except in front, where it is lobulated. It measures 20μ in diameter. It is 50μ from the pharynx to the genital pore, that is from the division of the coeca. The oesophagus is very short, not more than 10μ , and the coeca are large and lobulated and on each side the angle returns towards the head, nearly to the pharynx, after that they proceed on each side in wide lobulated curves to the extreme end of the worm. Cirrus sac, 180μ long and 35μ wide. Ovary round, 25μ across. The amount of vitellaria is little compared with other forms. The glands extend 160μ on each side. Testes, 30μ in diameter. The intestines are quite clubbed at the posterior end. The cirrus is large and generally exerted.

Telorchis guttati, sp. nov.

(Fig. 40)

Host—*Chelopus guttatus*.

Habitat—Intestine.

Locality—Zoological Park, New York.

This worm is a mature female full of eggs and is 8 mm. long and 1 mm. wide. It was found on January 4, 1918, in the intestine of a spotted turtle, *Chelopus guttatus*, and is a fine specimen of a *Telorchis*. It is pointed at both ends. At the anterior end, the mouth sucker is somewhat conical in shape, being narrower posteriorly than in front. It is 15μ long and at its widest part also 15μ , with the mouth proper in the centre. It has a very short prepharyngeal oesophagus this being about 5μ long. The pharynx is 8μ long and 10μ wide, lobulated entrance. Oesophagus, narrow and 35μ to the division, and 90μ from

there to the genital pore. Anterior third of the body, spiny. Cirrus sac 200μ long. Acetabulum about the same size as the pharynx. The metraterm 101μ and studded on its outside by numerous unicellular glands. Ovary, 25μ in diameter and situated at the end of the cirrus sac. Vitelline ducts plainly visible, Laurer's canal and the seminal reservoir not seen. Eggs 5μ long and 3μ wide. Vitellaria delicate and extending from ovary in front to near testis behind. Uterus fills up the body cavity between the intestines and in places overlaps them. To the left of the cirrus sac is a water vascular reservoir 30μ long and 10μ wide. It is situated dorsal to the cirrus sac. The testes are two, very near the posterior end and situated between the ends of the intestines, where these latter are much lobulated. The vitellaria are very plentiful, they extend from a point some distance in front of the ovary to near the anterior testis posteriorly, and the glands are in clusters. The posterior reservoir is 100μ long and dorsal to the testes. This worm is much like No. 2 as shown in Stunkard's worms, only it is larger. In fact, it is difficult to compare these worms for some writers must measure immature forms. An average size of the mature specimens would render the diagnosis much easier.

Distomum auritus, sp. nov.

(Fig. 41)

Host—*Aplodinotus grunniens*.

Habitat—Small intestine.

Locality—New York Aquarium. Nearby fresh-waters.

During the examination of a fresh-water drum, *Aplodinotus grunniens* Rafinesque, 1818, June 26, 1916, kindly sent me from the New York Aquarium, there were found in the intestine a lot of distomes. The fish had died of a severe attack of myxosporidia, and as usual, when a fish is in a weakened condition, that state seems to encourage the infestation of its parasites. The same rule holds good in the animal, as well as in the vegetable kingdoms. In this case the gills were found to harbor *Microcotyle* and the intestines had in them a number of very lively distomes, which I have ventured to name according to a very prominent external feature. The skin about the head is redundant, and the ear-like appendages are merely rolls of this which keep in the forms of ears. Although the host had been dead for a few hours, the worms were still very much alive, extending themselves and herding and clinging together. The mouth sucker is large, subterminal, and circular, and immediately posterior to it is a fairly large pharynx, followed by a curving oesophagus. This organ is long and divides at the junction of the anterior fifth with the posterior four-

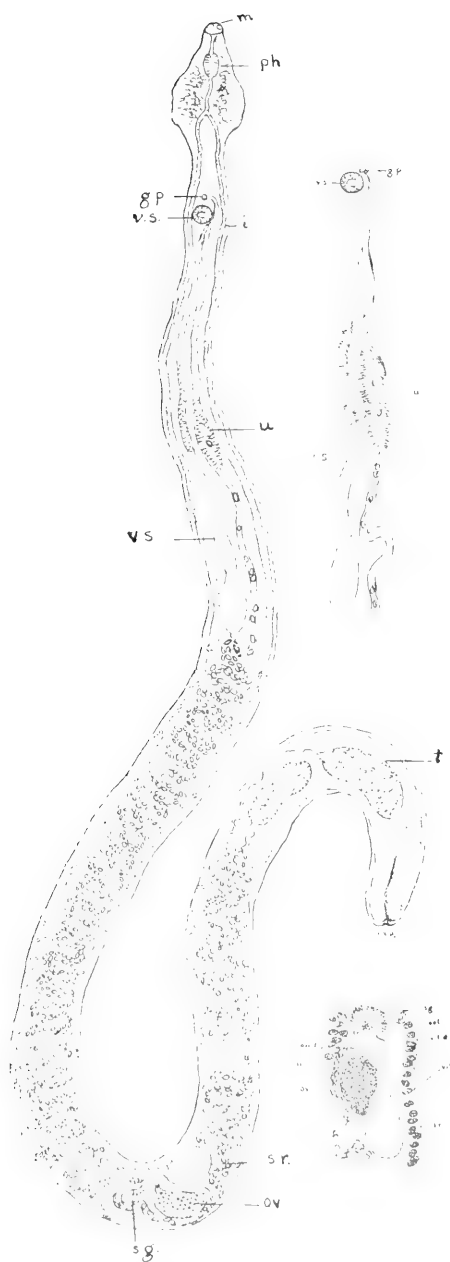


FIG. 42. *DISTOMUM SPICIFERUM*. FIG. 42 A. METRITERM AND DUCTUS ERICTORIUS. FIG. 42 B. GENITAL SCHEME.

fifths of the body length. The coeca are relatively large and extend to nearly the posterior end of the body. The acetabulum is situated one-third of the length from the head, and a short distance anterior to this is the genital pore. Almost immediately behind it on the right side is the ovary, the oviduct from which first proceeds backward to join the vitelline ducts, and the duct from the seminal reservoir. The ootype and shell gland are also here in the centre of the body, but Laurer's canal and the ductus genito-intestinalis were not seen. The testes are two, one rather cubical in form and the posterior one conical. The vas deferens enters into a good-sized cirrus sac. Eggs, large but not numerous. The vitellaria, very profuse. Skin, smooth.

For the purposes of classification, this, which averages in length 3 mm. and .40 mm. in width, probably belongs to the family *Allocreadium* Lss, with *A. isoporum* as the type; although the description does not quite correspond, nor does it correspond with the description of *Isoporum armatum* of W. G. MacCallum.

Distomum spiculiferum, sp. nov.

(Figs. 42, 42a, 42b)

Host—*Acipenser sturio*.

Habitat—Intestines, spiral valve.

Locality—New York Aquarium.

This peculiar worm was found in the spiral valve of an *Acipenser sturio*. There were twelve or fifteen of them. The host died at the New York Aquarium and was a very old and large specimen, weighing probably about eighty pounds.

The worm is quite large and has a spear or arrow-head-shaped head, and this on the surface shows numerous canals, probably part of the water vascular system, and since they are stained with carmine they look exactly like the capillary circulation in an inflamed part of an animal. The head is 170 μ across and 200 μ long, and quite snake-like in appearance. The mouth is terminal and has a buccal sucker on each side. It is 15 μ in diameter. The prepharyngeal oesophagus is short, about 10 μ long. The pharynx is 20 μ long by 10 μ wide, and the post-pharyngeal oesophagus is 30 μ long before it divides into the coeca, and the genital pore is about 100 μ posterior and just anterior to the ventral sucker or acetabulum, which is relatively small, being 25 μ in diameter. The worms average .22 mm. in length by 17.50 μ in width at the widest part. The most peculiar feature is the character of a portion of the interior of the vesicula seminalis and also a portion of the interior of the uterus, as these organs approach the end of their course. The vesicula seminalis is large at the posterior end and very long, terminating

in the cirrus, and the canal is studded throughout its lumen with rather large spicules which are thick at the base and from 5μ to 8μ long. They extend throughout a distance of 180μ , after which the prostatic muscular portion of the cirrus is as usual. The uterus also presents this peculiarity throughout a distance of 210μ , and here the organ is twice as wide as elsewhere. It is fusiform in this locality. The spicules are about the same size as those in the vesicula seminalis, but seem more plentiful, are apparently tangled up some, and some of them are loose. Many eggs are seen in the uterus at this part at the same time. The eggs are 4μ long by 2.50μ wide, are yellow and oval. The uterus fills the greater part of the body and is full of eggs.

The ovary is situated at about the junction of the posterior and middle thirds of the body, where is also plainly seen the genital junction, the seminal reservoir, and the shell gland. The ovary is 40μ long and 30μ wide. The testes are two oblong bodies very near the posterior end. They send two separate vasa efferentia forward throughout half the length of the worm to join the vesicula seminalis. The testes are 230μ long by 70μ wide. The intestines extend quite to the posterior end and there between them is the excretory pore. The vitellaria are situated on each side as far as the body of the uterus extends.

Eurema keksooni, gen. et. sp. nov.

(Fig. 43)

Host—Small Ray.

Habitat—Gills.

Locality—Singapore.

On July 20, 1916, there was found on the gills of a small unspotted ray a small worm which is unusual. It was found at Singapore by Lee Kek Soon, who was assisting Dr. W. G. MacCallum. He said it was from the gills, but as a matter of fact, it was found at the bottom of the dish after washing the gills and may have come from the gullet or mouth. He was confident, however, that it came from the gills. The spiral valve of the host yielded several cestodes of different species.

The anatomy of this worm is so unusual that it could not escape being classed as a new genus and species. The mouth is an unusually wide, loose, open structure with, apparently, the pharynx opening at once between the lips, or immediately behind them at the middle of the wide mouth. The head is much wider than the neck, and the lips extend the entire width of the head. The neck is short and the body begins to enlarge at once. At the shoulders, as it were, or near the widest part of the body is seen on each side a distinct prominence, like that in some of the *Polystoma*. On close inspection, these two

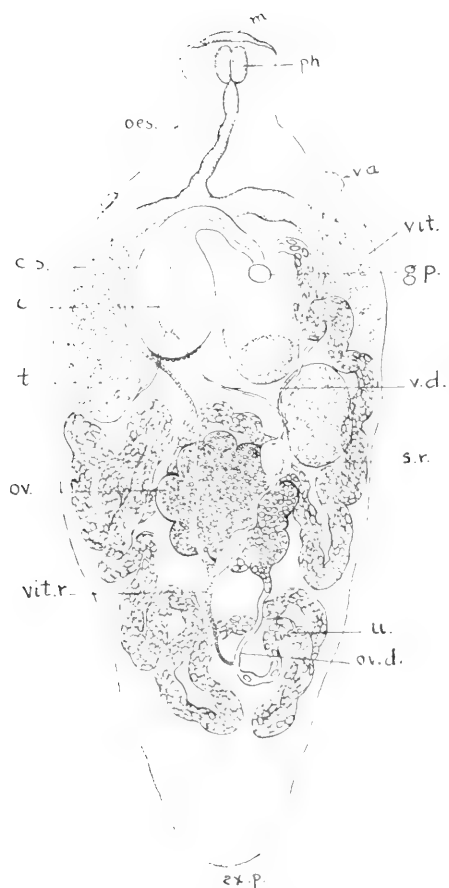


FIG. 13. TURBOT (TURBOTUS).

proved to be the entrances, for there are many, to the vagina. This feature in itself is peculiar, for the worm has not any of the other features of a polystome. Between these two structures and slightly posterior to them, yet in the middle of the body, is the acetabulum, of good size. The vaginae both lead backward and inwardly, one to join the large and widely-spreading right hand main duct of the vitelline reservoir, which proceeds superficially over and ventrally to the large ovary, to a point considerably posterior to that organ, where it helps to form the genital junction, partly under massive folds of the egg-filled uterus. The other passes through a seminal reservoir and on to join the left branch of the vitelline reservoir. The pharynx is an unusually large structure for so small a worm, and it is exceedingly muscular. There is no prepharyngeal oesophagus, but the oesophagus posterior to the pharynx is large and fairly long before it divides into the ceca. These are voluminous and extend nearly to the end of the body. The ceca enclose the genital pore in front of the acetabulum. This is overlung by a relatively large muscular cirrus, which is partly enclosed in a wide cirrus sac, the posterior end of which is covered with a number of round, cell-shaped pedicles or papillae. The ovary is a large lobulated structure situated in the centre of the body, and posterior to the acetabulum. Anterior to it and to the left is seen the seminal reservoir, with the vagina, on that side, entering its base. The vagina on the other side may, and probably does, enter the right arm of the vitelline reservoir. The uterus is large and its folds fill the posterior part of the body and as far forward as the acetabulum. The water vascular system is plainly visible on each side of the neck, in the form of three branching tubules. At the posterior end of the worm, at its centre is the excretory pore, with small tubes concentrating to it from the fairly wide posterior end. The skin is smooth, thick, and unarmed. The eggs are oval and yellow.

Measurements of Eurema keksooni

Length	3.00 mm.
Width	1.20 mm.
Head width40 mm.
Pharynx width	15 μ
Pharynx length	20 μ
Eggs length	2 μ

Paramphistomum chelydrae, sp. nov.Family—*Paramphistomidae* Fisch.Genus—*Paramphistomum* Fisch.

(Fig. 44)

Host—*Chelydra serpentina*.

Habitat—Rectum.

Locality—New York Aquarium.

The worms which form the basis of this short paper were found on March 17, 1915. There were three of them in the rectum, all mature, containing eggs, were all of the same size, and I believe adult specimens. They were 5.50 mm. long and 1.60 mm. wide. General outline of the body oblong, narrow at the mouth, becoming wider until about the middle, where it reaches its greatest width. Then this gradually lessens until nearly opposite the middle of the disc, when it suddenly ceases and ends in the middle of the side of the disc, thus forming an angle, which, as far as I know, has been unusual in this genus. The disc, thus is shown to extend half of its length past the end of the body.

The plate given here is as accurate as a toto mount could be made. No oral evaginations or coeca can be seen in the mouth sucker of two of the worms, but in the third they can be seen, and it is to be presumed that they are also present in the others, for this is very common in the *Paramphistomidae*. The mouth sucker is terminal and bowl-shaped, 80 μ long and 60 μ wide. Opening of the mouth, which is terminal and corrugated longitudinally is 25 μ from side to side. Oesophagus, including the oesophageal bulb or pharynx, 80 μ long. The bulb or pharynx is situated just anterior to the division of the intestinal coeca, and is 25 μ long and 25 μ wide. The intestines are very irregular in shape and extend to within a short distance of the posterior sucker. The genital pore is central and placed in the angle of the coeca. The ovary is perfectly round or globular, and is 30 μ in diameter. It is situated a considerable distance posterior to the testes. The genital junction can be fairly well defined posterior to the ovary. The uterus is a comparatively short tube, and generally contains three eggs which are 20 μ long and 12 μ wide, oval and yellow. Testes are placed well towards the anterior part of the body cavity. They are irregular in shape, indeed quite branched or clubbed, one 43 μ long and 25 μ wide, and the other 50 μ long and 40 μ wide, one in advance of the other, and in all three specimens, the internal organs are very much alike. Vitellaria plentiful, extending from near the genital pore on each side to near the end of the intestines posteriorly, and all across the body in large masses. The disc is rounded or rather oval, the central opening being cordate in shape, with the small end posterior. The two angular portions of the body are situated opposite the middle of the margin of the disc, and extend in a line across the middle of



FIG. 13. *PARIMPHISTOMUM CHELYDRAE*

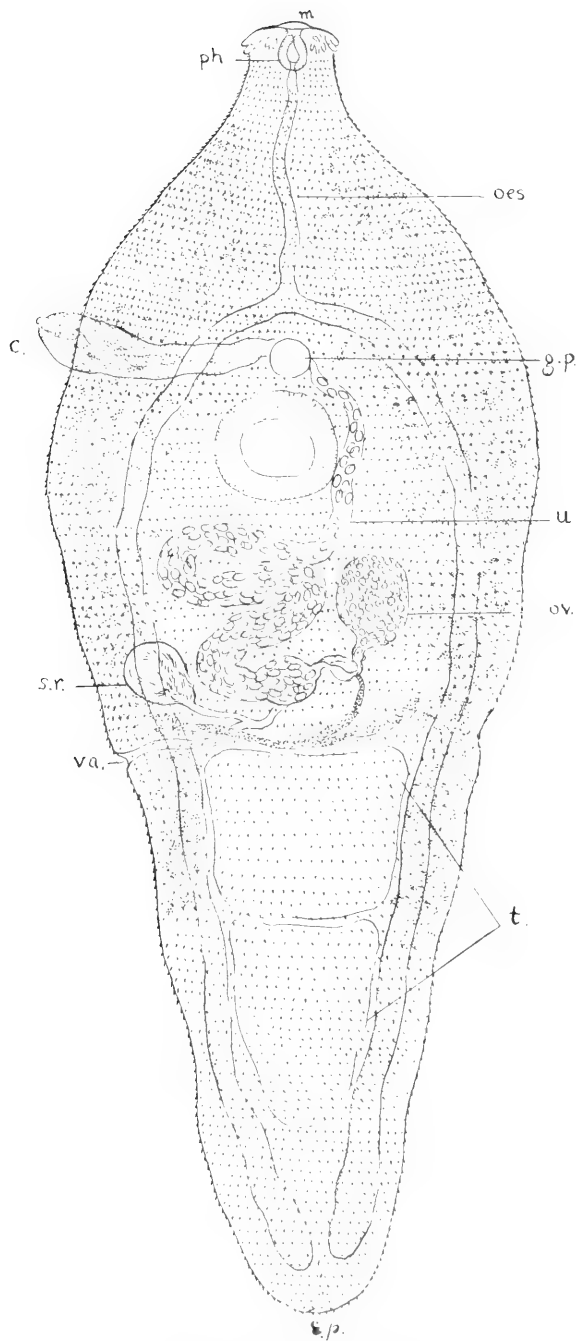


FIG. 48. *ECHINOSTOMUM HIRODIARUM*.

the disc dorsally, so that the posterior half of the disc projects beyond the body of the worm. It is 130μ anteroposterior and 115μ across, and internally 75μ and 45μ . The excretory pore is large and situated just anterior to the disc in the middle of the body.

An odd thing about these particular worms is that they were all infested with great numbers of small yellow cysts, which may or may not have been calcified before death, however, they now appear throughout the parenchyma and over the surface of the organs as small round bodies.

Echinostomum herodiae, sp. nov.

(Fig. 45)

Host—*Herodias timoriensis*.

Habitat—Gall bladder and ducts of aquatic birds.

Locality—Java.

This worm was found by Dr. W. G. MacCallum in the gall bladder of *Herodias timoriensis* in Singaradja Bali. Several were found and from its exceedingly spiny skin, it must have been a source of great irritation to its host. It is spear-shaped and the head shows the mouth terminal and surrounded by several long papillae. The anterior portion of the head is unarmed, but the skin throughout over the body is covered thickly with prominent chitinous spines arranged in transverse rows across the body so thickly indeed that they overlap somewhat. The pharynx is very close to the mouth and is 15μ long by 10μ wide. The oesophagus is long and tortuous, is divided at the junction of the anterior and second-fifth of the length of the body. The coeca spread widely and enclose a large genital pore, from which the cirrus is generally seen exerted. This is large and club-shaped, and measures 100μ in length. The genital pore is at the anterior margin of the acetabulum, and this latter organ is 100μ in diameter. The ovary is irregular in shape, is about 50μ in diameter, and is situated almost directly behind the acetabulum. Wide vitelline ducts meet the oviduct here from each side, as does also the duct from the seminal reservoir. This sac is to the left of the ovary. Laurer's canal can not be made out with certainty on account of the presence of numerous large eggs, which are 7μ long by 4μ wide. The testes of which there are two, are large and are of different size and shape. The anterior one is irregularly square, filling largely the abdominal cavity from side to side. It measures 1.40 mm. across, and 80 mm. from before backward. The other is more or less conical to fit the posterior part of the body cavity, and is about 1 mm. long by .60 mm. wide. The intestines extend to the posterior end of the body and are there club-shaped. A large excretory pore opens at the posterior end and one

can see a system of ducts coming from the body. This worm looks somewhat like that described by Ramsay Wright as having been found in *Botaurus minor* North America, and named by him *E. asperum*.

Measurements of E. herodiae

Length	8 mm.
Width	3 mm.
Acetabulum	100 μ in diameter
Head across	45 μ

Axine carangis, sp. nov.

(Fig. 46)

Host—*Caranx hippos*.

Habitat—Gills.

Locality—New York Aquarium. Common on East coast.

The name *Axine* was first given to this genus by Abilgaard in 1794, but this particular species appears to be new.

This worm was found in great numbers on the gills of a *Caranx hippos* after they had caused the death of their host. It is a very graceful creature, perhaps the most delicately shaped of all the *Microcotyle*. The head begins with a small protuberance, presumably the mouth or lip and on each side of this and immediately behind it, is the mouth proper with a buccal sucker on each side. A short distance posterior to this is the genital pore, which is divided into two portions of a circle, each being surrounded with a row of spines or hooks, and a very short distance posterior to this appears the armed head of the cirrus, and still further posterior in the middle of a more or less clear circular space is the opening of the vagina which is also armed with very fine spicules. This opens on the dorsal surface, as in other members of the microcotyle family.

The uterus is usually filled with a column of fusiform eggs making their way to the genital pore where they are ejected or laid. At either pole of the egg is a long filiform filament which, when the egg is laid, becomes attached to the filaments of the gills, where it is retained until hatched. The ovary which is an irregularly-shaped mass of germ cells enclosed in a roughly horseshoe-shaped sac, lies about the middle of the worm. The vitelline reservoir, which receives the spermatozoa from the vagina, lies in a somewhat V-shaped structure and adds its share to the oviduct in the formation of the egg. The seminal reservoir is always plainly to be seen in this locality, and behind this genital junction are situated the testes, about forty or fifty in number. The vitellaria are very profuse and extend from near the

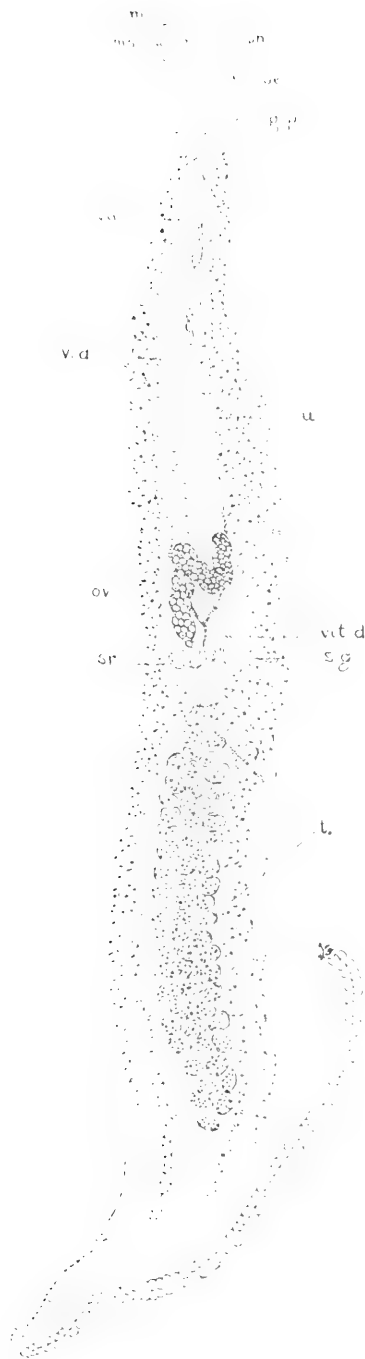


FIG. 46. *TYNOCIRRIUS*.

Zampieri and *Vaccaro*, *Parassitologia*.

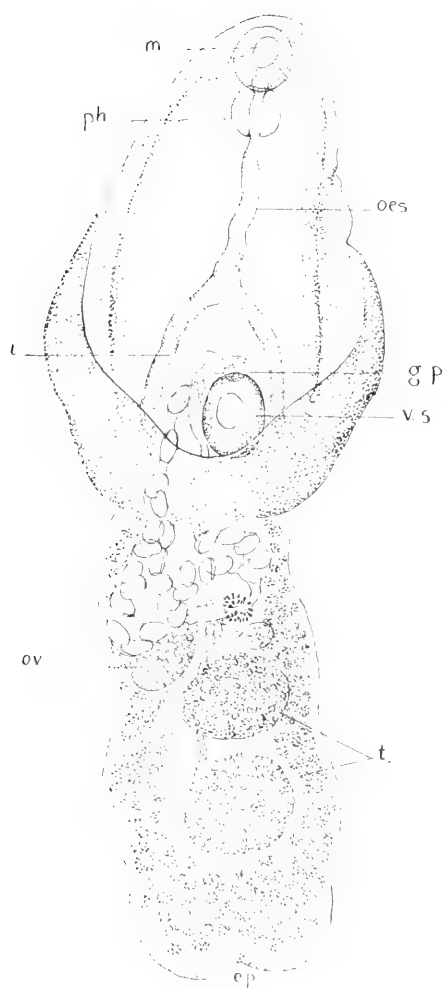


FIG. 37. *HYMENOSTOMUM HIRSUTUM*.

head on both sides of the worm into the disc at the posterior end. This latter structure is very graceful. It has a single row of clasps along the margin. They seem to be of about the same shape as those of the *Microcotyle*, but are more delicate. The disc is the widest portion of the worm, being about 1 mm. in width and shows about 90 suckers along its margin. The body of the worm at its widest is only about .80 mm., and it is only 7 mm. long.

They seem to be very productive, for like the *Microcotyle*, they often cause the death of the fish they infest from sheer loss of blood probably plus the poison which all of these worms are said to impart to their host.

The fish was kindly sent for examination by the Director of the Aquarium.

Hemistomum haustum, sp. nov.

(Fig. 47)

Family—*Holostomidae*.

Genus—*Hemistomum*, Diesing.

Host—*Alutera schoepfi*.

Habitat—Intestines.

Locality—Southeast coast of the United States.

On May 4, 1915, a large, but very thin *Alutera schoepfi* was kindly sent me from the New York Aquarium. On examination, it was easy to see why this host was emaciated. On the gills was a good-sized *Branchiobdella* about 1½ inches in length. In the urinary bladder were a lot (46) of *Catoptroides aluterae*. On the gills there were a great many small copepods, and in the intestine a number of small distoms of two or three species, also a lot of *Hemistominae*, which I am about to describe. There were forty or fifty of this species recovered, which are so very unusual in form. It is roughly somewhat the shape of a scoop, such as is used by grocers, the tip being the head where appears the subterminal mouth sucker followed without interval by the pharynx. The oesophagus is long and divides into the coeca about the middle of the dilated portion of the anterior half of the worm. In the somewhat triangular space enclosed is the acetabulum, and just anterior to this the genital pore. At this point too may be seen the adhesive disc which covers in largely the acetabulum. The intestines appear to extend nearly to the posterior end of the worm on the dorsal surface of what might be called the handle of the scoop. The eggs in the uterus are also nearer the dorsal than the ventral surface. There are two good-sized rounded testes and in front of them to their right is the ovary, which is about half the size of a testis. The oviduct is given off from the left side and posterior to this tube is

the seminal reservoir, and here too is situated the genital junction of the vitelline tubes, oviduct, and ducts from the seminal reservoir, all near the ootype and shell gland. The other ducts supposed to be seen here, Laurer's canal and the ductus genito-intestinalis, so seldom seen by me without sectioning, are not to be seen here in a toto mount, even if they are there. The vitellaria are very plentiful throughout the posterior half of the body, and in fact, all of the organs seem confined to this portion except the outlet of the uterus and the cirrus with its sac. The vasa efferentia join to the form the vas deferens, which, as usual, ends in the cirrus sac.

Measurements of H. haustrum

Length	2.25 mm.
Width	1.00 mm.
Width of posterior part of body60 mm.
Egg oval05 mm.
Mouth sucker20 mm.
Pharynx length150mm.
Ovary40 mm.
Testis60 mm.

Spirorchis, gen. et. sp. nov.

(Fig. 48)

Host—*Chelopus insculptus*.

Habitat—Intestine.

Locality—New York Aquarium.

These three very unusual worms were on January 4, 1917, found in the intestine of a wood turtle. As will be seen by the color of the contents of its intestines, it is a haematophagic trematode. It is 4 mm. long by .80 mm. wide, with a smooth skin throughout. Its body tapers toward each end, being widest about its middle. The anterior end displays a mouth sucker, which is almost entirely external to the head, being joined thereto by a prepharyngeal oesophagus, 30 μ in length. The postpharyngeal oesophagus being 25 μ . The coeca begin at about 60 μ from the mouth. The pharynx is not more than 5 μ in diameter. Almost at once in the angle of the coeca, the testes begin by a conical mass, which is followed by nine other irregularly-shaped masses, all joined together in a rough spiral column filling almost the whole abdominal cavity between the intestinal coeca. They finally end in close touch with a large, more or less conical-shaped seminal reservoir, which in itself, is larger than any one of the testes. Its base is anterior, and it gradually tapers into what probably is the cirrus, although, on ac-

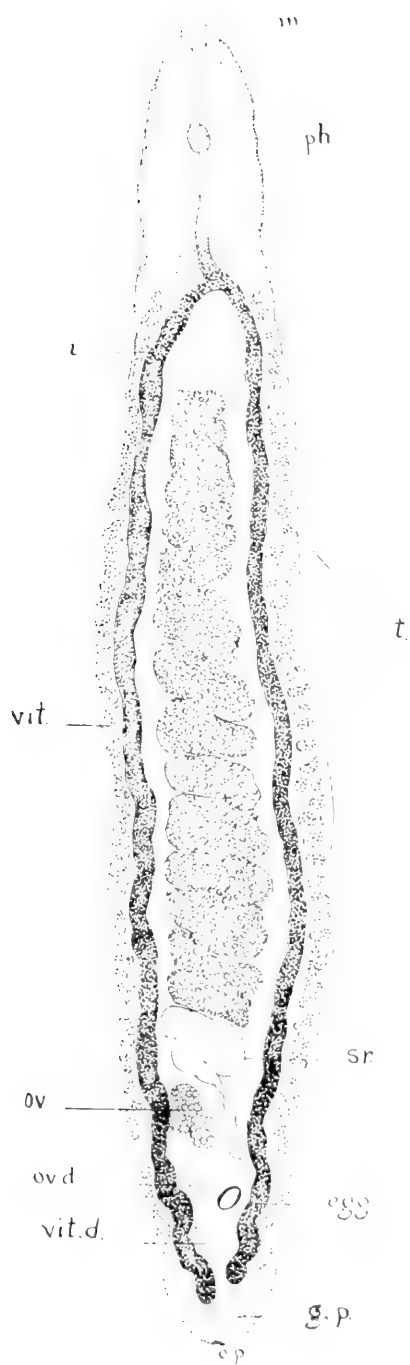


FIG. 48. SPOROCHLONIA

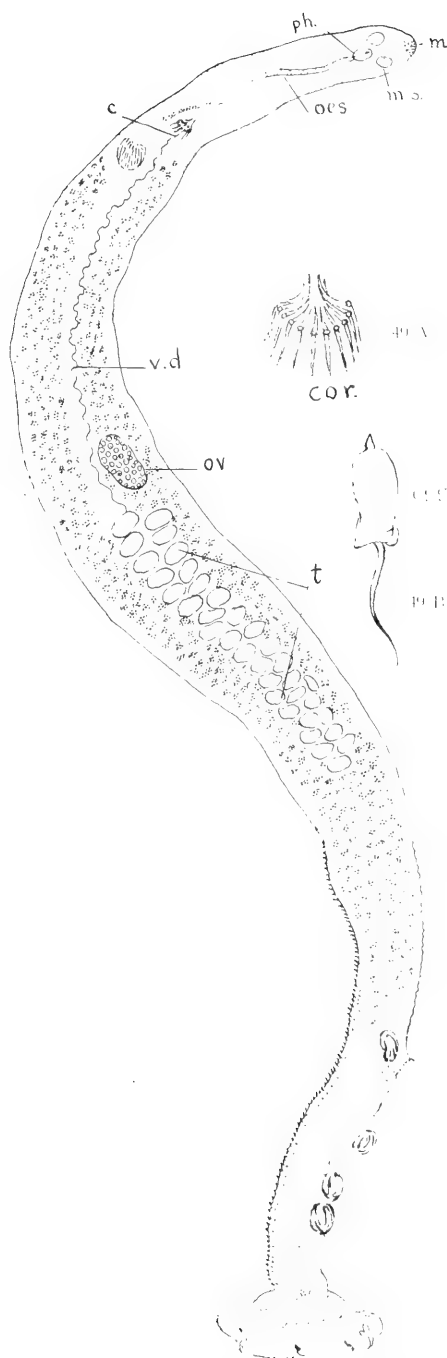


FIG. 49. *ACANTHODISCUS MIRABILIS* FIG. 49 A. CORONET. FIG. 49 B. EGG.

count of the black intestines filling the posterior end of the worm, it is not possible with the material at hand to trace the genital scheme. The vitellaria are very profuse, and the ordinary Y-shaped reservoir can be plainly seen. The ovary 20μ in diameter with a long oviduct directed posteriorly is seen near the end of the seminal reservoir, but no ootype or shell gland or other seminal reservoir can be seen, nor indeed, can the uterus be made out. One large, oval egg, 10μ long and 5μ wide, is seen posterior to the ovary in each specimen. The shell of this seems thick and cleavage is well advanced. The genital pore is a little posterior to the tips of the coeca and between them. It is more or less circular, but its connection with the oviduct or uterus cannot be seen, indeed, in one case the black coeca have coalesced and formed a large black mass over this interesting region. No acetabulum or other adhering organ seems to be present. The usual excretory pore is to be seen at the posterior tip of the body. On account of the unusual spiral mass of testes, filling the abdominal cavity to the exclusion of everything else, I have taken the liberty of naming the worm *Spirorchis* as a gen. et. sp. nov.

Acanthodiscus mirabile, gen. et. sp. nov.

(Fig. 49)

Host—*Caranx hippos*.

Habitat—Gills.

Locality—New York Aquarium.

The host is common on both the east and west coasts of the United States.

This very strange ectoparasite was found on April 18, 1917, in considerable numbers on the gills of a crevalle, and I have no doubt that at times the species may be a serious menace to the life of the fish.

One can hardly say how many were on the gills, for as the worm is so small and filmy, hundreds or more might easily be overlooked. It is evidently a heterocotylean trematode, but does not seem to fit into any known genus. For the purpose of classification, it may be described as elongated, flat, two-mouth suckers, many testes, peculiarly armed cirrus, body towards posterior disc transversely striated and spiny along dorsal surface with four claspers on opposite side, and with a fairly large terminal disc without suckers, but armed with two large hooks and several small ones. I would like therefore to suggest a new genus of the family *Gyrodactylidae* v. Ben et. Hesse.

The anterior end shows a mouth with two buccal suckers, much like those of a Microcotyle. Behind and between these is a small pharynx followed by a rather long gullet, but which is in no case

visibly divided into coeca, although a number of specimens were examined. The location of the genital pore is indicated by a flat plaque of amber colored chitin, and near it is seen a most peculiar head of the cirrus with a coronet of about twenty spines. (Fig. 49a.) This ornamental structure is at the end of a long tortuous vas deferens arising from a cluster of forty or more testes, which resemble those of the microcotylidae. The ovary is of a relatively fair size, situated a little anterior to the middle of the worm. It is, however, in the material at hand impossible to make out the whole female genital apparatus, although plenty of specimens, well stained, were under observation. The vitellaria were very plentiful and offered some obstruction to making out the anatomy. These glands extend from the genital pore on both sides throughout two-thirds of the worm's length. Along the dorsal surface for about one third of its length, the body of the worm showed its skin armed with sharp spines, looking chiefly towards the posterior and chiefly dorsal. On some portions also of the posterior part of the body, spines may be seen on the abdomen, and in this region of the spines, the body is seen to be crossed with transverse striae. An odd feature, too, is the presence on the abdomen just anterior to the disc of four relatively large claspers or chitinous suckers. These are oblong and of a different structure to those in the axine or microcotylidae. Still, they are of the same character. Three of these, the posterior ones, are placed near to and in advance of each other, while the anterior one is placed some distance anterior to the others, and it too seems to have at its base a flap of thin, semitransparent skin, which extends past the margin of the body.

The disc is a relatively large, saucer-like structure with two fairly large hooks attached to the under margin, and also along the edge of the disc are seen from the one side four other small hooks. If distributed evenly around the margin of the disc there would probably be in all eight of these small hooks. Only two large ones are seen, however. The egg seen in the uterus, is also odd. (Fig. 49b.) It is relatively very large with an anterior spike and a posterior filament. It is somewhat wrinkled.

Measurements of A. mirabile

Width	20 μ
Disc diameter	33 μ
Disc depth	15 μ
Shield near genital pore	8 μ long x 5 μ wide
Egg length	15 μ
Egg width	7 μ
Length of spike	2 μ
Filament at posterior end ...	15 μ long
Across cirrus coronet	5 μ

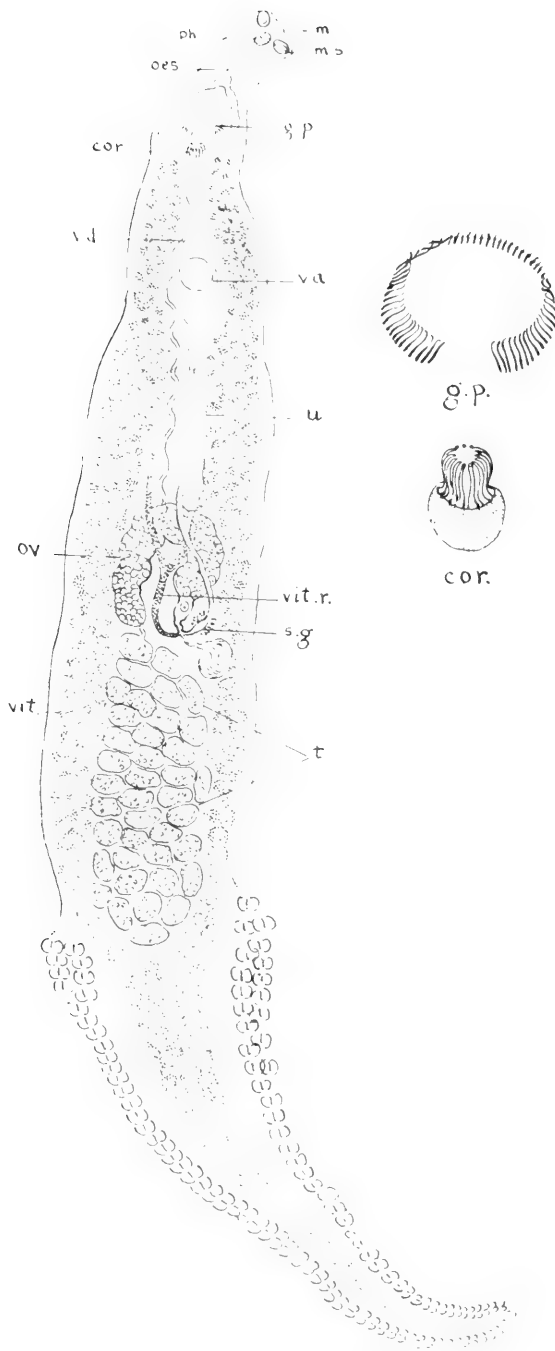


FIG. 5. *MONOCORYLE SPINICOLLIS*

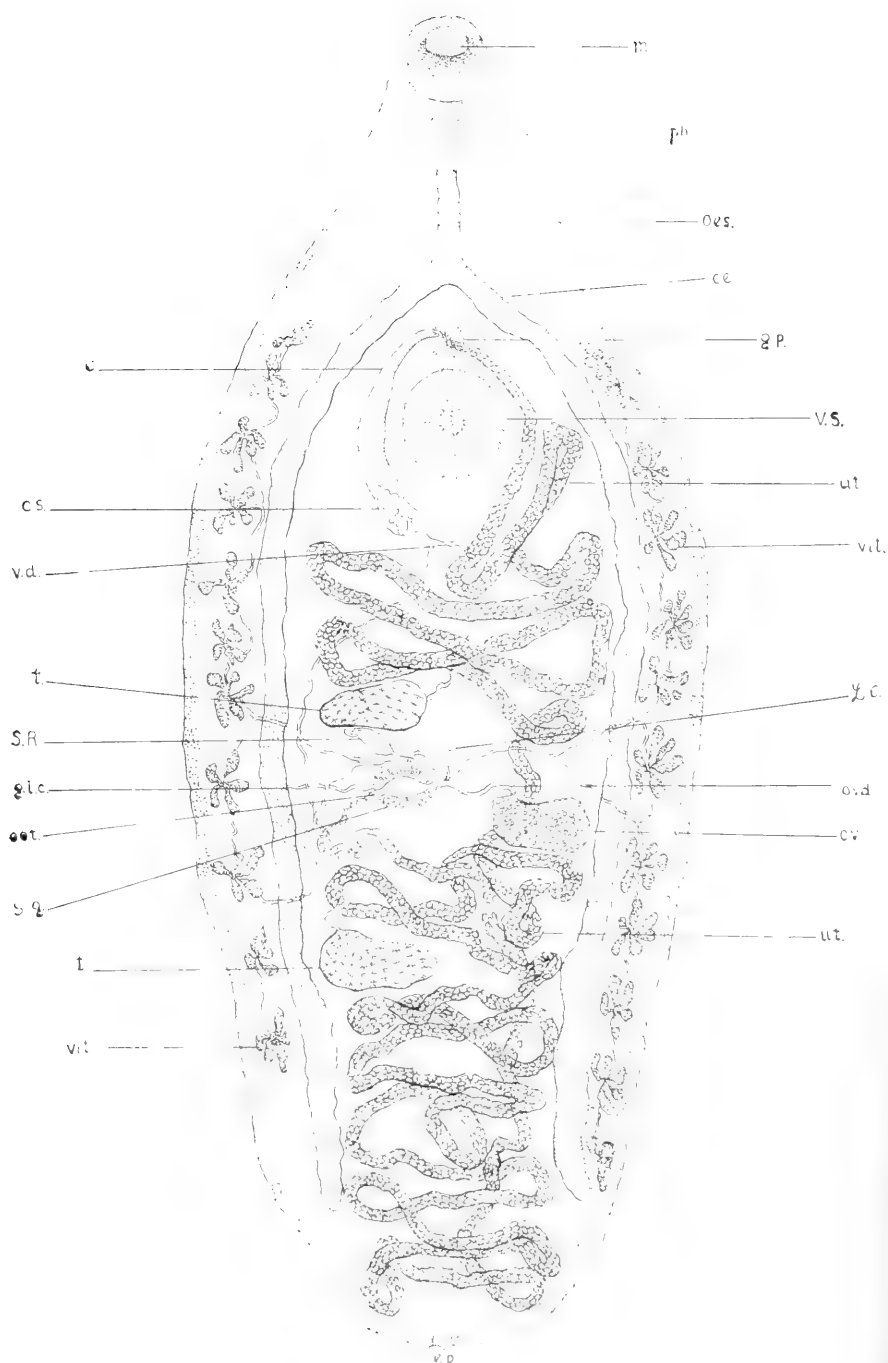


FIG. 51. STOMIUM TROPICUS.

Microcotyle spinicirrus, sp. nov.

(Fig. 50)

Habitat—Gills of the fresh-water Drum. Found in lakes and rivers in North America.

On January 31, 1917, a fresh-water drum, *Aplodinotus grunniens* was sent me from the Aquarium at New York. It was a large fish and yet its gills were found so infested with microcotyle that they undoubtedly caused its death. The gills were of a cream color, although the fish had recently died. The worms had practically exhausted most of the blood.

This *Microcotyle* is not large and is rather gracefully formed. Its sucker disc is triangular in shape and as many as eighty or ninety suckers or claspers may be counted on it. The head is rather square at the anterior end with the mouth in the centre, and on each side of this is a buccal sucker. Between and posterior to these is the pharynx followed by a rather long oesophagus, which divides as usual into two coeca, and between these branches of the intestine the genital pore is seen surrounded by a large ring of hooks, counted in two or three instances there were fifty-four. (Fig. 50.) At one point toward the posterior they are absent for a short distance in the ring. The ring is 20μ across and the longest hooks are 5μ long. Immediately behind the open space in the ring is the anterior end of the cirrus, which is a peculiar structure as shown in Fig. 50. The vas deferens leading to it is very tortuous and wide. A short distance still further posterior, is a clear circular space, in the centre of which can be seen the vaginal opening, also surrounded by a cluster of hooks or spines which are small. The opening is dorsal and the vagina empties into the vitelline tubes which go to make the Y-shaped vitelline reservoir, from which a small tube joins the oviduct before the latter merges into the ootype as usual, though the duct from the seminal reservoir joins the oviduct first. The ovary itself is a horseshoe-shaped tube placed across the middle of the worm with the convex portion looking anteriorly. The testes are in the posterior end of the body, and are forty or fifty in number. The vitellaria are distributed along the sides of the body from near the genital opening almost to the tip of the sucker disc.

Measurements of Microcotyle spinicirrus

Length varies very much. An average would be 5 mm.

Width 1 mm.

The disc about one-third the length of the worm.

Distomum tropidonoti, sp. nov.

(Fig. 51)

Host—*Tropidonotus trianguligerus*.

Habitat—Gall bladder.

Locality—Buitenzorg, Java.

On May 25, 1916, Dr. W. G. MacCallum found at Buitenzorg, Java, in the gall bladder of a *Tropidonotus trianguligerus*, a brownish-green snake, a solitary distome. Its mouth is sub-terminal, unarmed and is large, and it terminates in a short gullet or prepharyngeal oesophagus. The pharynx is roundish and is followed by the oesophagus, which is comparatively long. This, as usual, divides into the intestinal coeca, and in their angle is the genital pore, the cirrus and the uterus presenting here. In the centre of the body, nearly at the anterior quarter of its length is the acetabulum, the genital pore being in front of this. The ovary situated in the middle of the body, is not so large as either of the two testes, which are placed one behind it and one in front, and both on the opposite side, one in advance of the other. The vasa efferentia meet each other at right angles, at or near the base of the cirrus sac, one is short and the other very long. The vitellaria are peculiar, being placed along each side in open hand, shaped clusters and giving out numerous vitelline ducts, several of which concentrate at a small vitelline reservoir between the ovary and the anterior testis. The ducts sent toward the genital junction are very distinct, as are also the ducts connecting the lobulated masses. In this position may be plainly seen the genital junction. The seminal reservoir is placed beside the posterior surface of the ovary, and sends its duct to join the oviduct just in advance of the duct from the vitelline reservoir. The ootype is seen surrounded by the shell-gland. The oviduct is continuous with the uterus, which coiling near the posterior end of the body, passes anteriorly to the end at the genital pore. The seminal reservoir is very distinct and lies against the posterior side of the anterior testis. It is situated on the right side of the centre of the worm, but by means of a rather long duct, it empties into the oviduct. Laurer's canal is given off the oviduct very near the ootype, and proceeds a short distance anteriorly before passing through to the back. The genito-intestinal canal is given off from near the ootype, and proceeds to the right coecum, where it enters. The ootype is large and is surrounded by a profuse shell-gland. The eggs are numerous, small, and yellow. The vagina can not be made out certainly. The skin is thick, unarmed, and somewhat corrugated, especially at the posterior end. The excretory pore is large and situated at the extreme posterior end of the body. The worm is only 5 mm. in length by 1.90 mm. in width.

Measurements of *Distomum tropidonoti*

Length	5 mm.
Width	2 mm.

Across mouth	20 μ
Pharynx width	10 μ
Pharynx length	10 μ
Oesophagus length	30 μ
Acetabulum	30 μ
Ovary	30 μ x 50 μ
Testis	65 μ x 30 μ
Cirrus sac length	20 μ
Egg	5 μ x 2.50 μ

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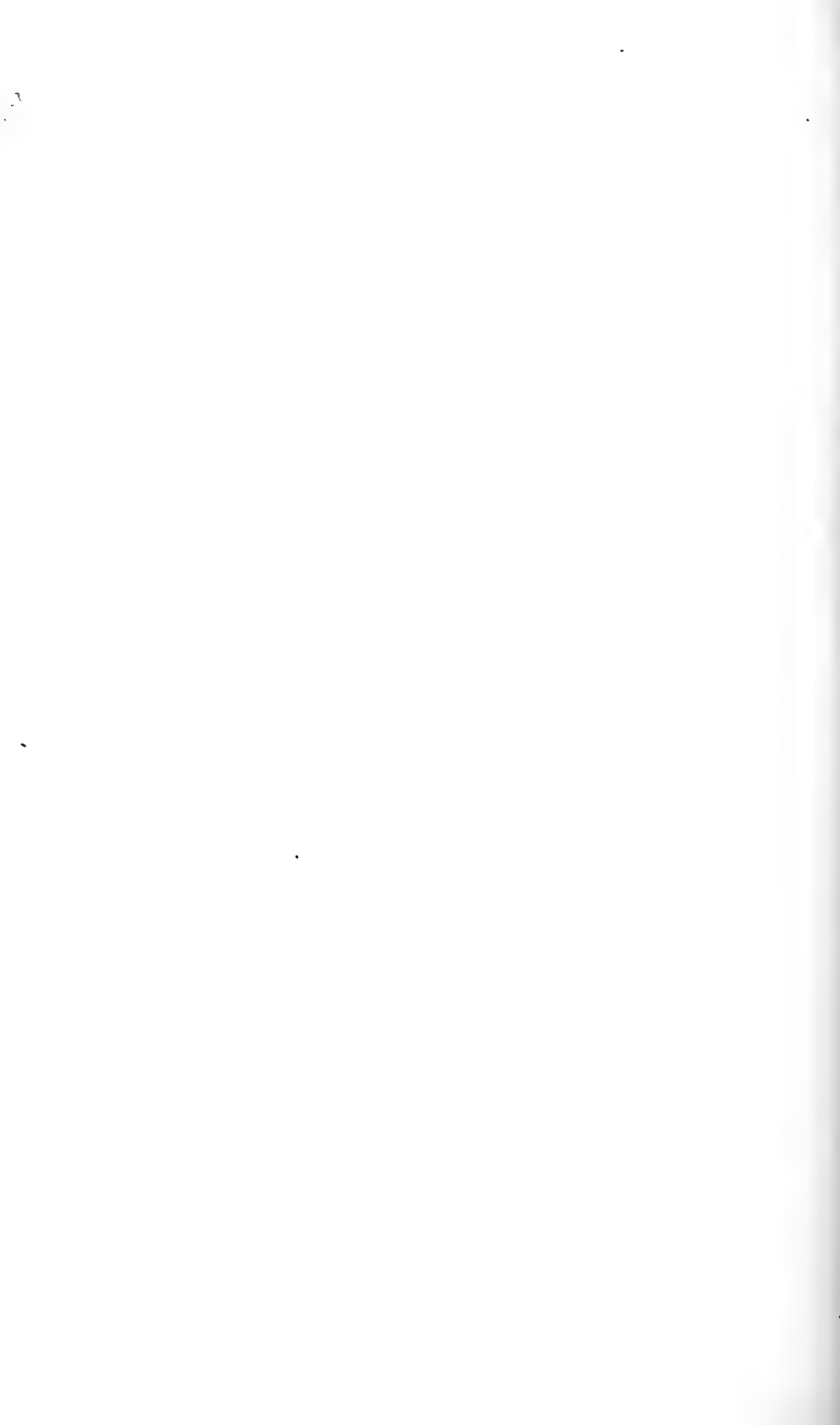
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STUDIES ON THE POLYSTOMIDAE

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ABBREVIATIONS

Abbreviations in explanation of plates :

a.—anus	o.s.—oral sucker
b.c.—buccal sucker	ov.—ovary
b.—bursa	oot.—ootype
b.e.j.—bulbus ejaculatorius	oe.—oesophagus
c.s.—caudal sucker	ov.d.—oviduct
c.s.—cirrus sac	oes.g.—oesophageal gland
c.p.—cirrus pouch	ph.—pharynx
cl.—cloaca or genital pore	p.p.—pars prostatica
ce.—coeca.	pr.—prostate
cor.—coronet	p.—papillae post and preanal
c.—cirrus	res.—reservoir
c.gl.—cement glands	s.g.—shell gland
d.e.j.—Ductus ejaculatorius	s.v.—seminal vesicle or vesicula seminalis
e.—eye	s.r.—seminal reservoir
ex.p.—excretory pore	sp.—spicule
ex.v.—excretory vessels	t.—testis
g.i.c.—genito intestinal canal	tr.—tridents
g.p.—genital pore	u.—uterus
h.—hook.	u.g.—unicellular glands
i.—intestine	v.d.—vas deferens
li.—ligament	va.—vagina
le.—lemnisci	vit.—vitellaria
l.c.—Laurers canal	vit.d.—vitelline duct
m.—mouth	v.s.—ventral sucker or acetabulum
m.b.—muscular bands	w.v.s.—water vascular system
m.g.—mucus glands	y.d.—yolk duct
met.—metraterm	y.r.—yolk reservoir

STUDIES ON THE POLYSTOMIDAE

Order—*Trematoda*.

Sub-order—*Heterocotylea*.

Family—*Polystomidae*.

Genus—*Polystoma*.

In 1808, when the order *Trematoda* was established by Rudolphi, it was made to include with other genera that of *Polystoma* (Zeder). In 1892, Monticelli proposed a new system, dividing the trematodes into three groups or sub-orders, the *Heterocotylea*, *Aspidocotylea*, and *Malacocotylea*, the first of which exactly coincides with the *Monogenea* of Van Beneden, and this arrangement has been generally adopted by recent authors (Pratt).

Thus, *Polystoma* (Zeder), according to this plan, will fall into the Sub-order *Heterocotylea*, Family *Polystomidae* Taschb. and Sub-family *Polystominae*, V. Beneden. These worms are usually found on the gills and in the urinary bladder of amphibians, and in the mouth, nose and urinary bladder of turtles. The posterior end has usually a disc, on which are situated six or more suckers. These suckers of polystomes consist of small, cup-shaped, circular discs, composed of muscular fibres in the wall, and arranged in various directions between the chitinous framework. These fibres are limited on the surface by a distinct membrane. The muscular fibres are so attached to the various parts of the chitinous framework that by their contraction, the cup-like cavity can be raised and narrowed so as to accomplish its sucking function. Other muscle fibres extend from the disc up into the body, so that the whole disc is under the control of the worm. The genus *Polystoma* is not always ectoparasitic since it is often found living in the urinary bladder of fish, amphibia or reptiles. It may also be sometimes found in the lungs and intestines. *Polystoma* have no metamorphosis. (Ray Lankester.)

The posterior adhesive apparatus presents a variety in *Heterocotylea*. No doubt, the single sucker at the hinder end of the body represents the primitive arrangement. This sucker, which is always simple and never armed in the *Malacotylea* is usually multi-loculate in the *Aspidocotylea*. This posterior adhesive organ is usually formed of six, seldom of eight, suckers on a strong disc, and it is usually armed in the *Heterocotylea*. The anterior buccal suckers communicating with the oral cavity are usually present. The vagina, single or double, but sometimes multiple as in the *P. integerrimum*. Common genital pore, median. The copulation of *Polystoma* has been observed (Zeller). It is probable that in the case of many of the *Heterocotylea* which live isolated on the gills of fishes, and where eggs are laid by them, they are able to self-fertilize themselves. This is borne out by observation

in *Distomum* species by Looss,, who finds spermatozoa within the uterus before the external pore is formed. They could, therefore, only have been derived from the ripe male organs, and further, in some species there is no penis, so that copulation could not have taken place. If self-fertilization may occur in a *Distomum*, there is every reason to expect its occurrence in *Heterocotylea* (Ray Lankester). "The eggs are laid in water, and when hatched the larvae swim freely in water by means of five incomplete girdles of cilia, of which the three anterior are incomplete dorsally and the two posterior, incomplete ventrally (Zeller)." "The young *Polystoma* makes its way from the mouth into the pharynx, and wanders along the alimentary tract to the rectum. On the formation of a cloacal bladder, the young *Polystoma* enters it. It is not till the third year that the parasite becomes sexually mature. The gill *Polystoma* parasites differ in several points from the cloacal form, notably in the absence of a vagina, and consequently in the impossibility of copulation." (Ray Lankester.)

"In *Polystoma*, each vagina opens through 20 or 30 small pores situated on the lateral swelling, and at its internal end, the vagina communicates with the transverse vitelline ducts, and in its course is sometimes dilated to form a spermatheca." (Ray Lankester). This latter statement does not seem to be quite correct, for many *Polystoma* are found with a single freely open vagina on each side, and without any lateral swelling whatever. "In the *Heterocotylea*, too, there is sure to be a narrow duct passing from the oviduct opposite the entrance of the vitelloduct to the right limb of the intestine. This genito-intestinal canal, whose true relations were discovered by Ijima, and since confirmed by Goto and all who have examined the matter, was originally called the internal vas deferens by von Siebold, and believed to be connected with the testis, close to which it passes. It was then looked upon as a means for direct internal fertilization. It appears to serve for the conveyance of superfluous yolk to the intestines which will serve as food." (Ray Lankester.)

I wish here to record in connection with these worms an observation made in the case of *Chrysemys scabra* and also in *Trionyx ferox*. During the examination of these turtles, I noticed that in each case there was a consolidation of the posterior fourth of one lung in the former, and one-third in the latter. In each case the diseased portion was removed and frozen sections made. The diseased tissue appeared to be a hardened mass of small round cysts, some containing cheesy matter, but the greater portion of them were cysts, which to the naked eye looked transparent. Even in the case where the egg with the brownish shell had been sectioned, I did not observe any segmenting or development. I was somewhat surprised to find that beside the inflammatory exudation and consolidation of the diseased lung, throughout the whole section were to be seen sections of brownish yellow, oval eggs, which resembled the eggs of *Polystoma*. In many cases merely the oval holes were left, where the sectioned eggs had dropped out.

I, at once, compared the measurements and found that *Polystoma* eggs measure in *P. digitatum* 30 μ and 15 μ , 25 μ and 12 μ and 25 μ and 15 μ , in *P. orbiculare* 0.21 and 0.24 mm. in diameter. In *P. aspidonectes* 20 μ and 10 μ , 15 μ and 10 μ . These were the two polystomes found infesting the turtles diseased. In the sections of diseased lung, the eggs measured 30 μ and 20 μ , 15 μ and 10 μ , none were larger and some smaller, as a rule those in the sections were smaller than the eggs measured in the mounted worms. However, the measurements are so close and the appearance of the eggs corresponds so closely with those in the worms, that one is forced to the conclusion that the condition of the lung in each case was owing to the deposit of great numbers of polystoma eggs. In one case a live *P. digitatum* was found in a bronchus very near the diseased mass. I also think that the sections showed in one or two instances the cross sections of the larval worm itself. If this deduction is true, and I am sure it is, then the life history of *Polystoma* must be changed, at least in some instances. In each of the turtles examined, there were polystomes in the urinary bladder and also in the nasal cavities. In the one instance, that of *Trionyx ferox*, there were fifty or sixty worms in each location. This subject will bear further study, although I believe that what I have stated above will be found correct.

Polystoma troosti, sp. nov.

(Fig. 52)

Host—*Chrysemys troosti*.

Habitat—Urinary bladder.

Locality—New York Aquarium. Southern States.

On May 23, 1916, there were found in the urinary bladder of a Troost's terrapin, *Chrysemys troosti*, an odd *Polystoma*, which is unlike any other polystoma as far as I know, which has been hitherto described. There were only two specimens recovered, but as they are fairly perfect, they will serve for description. The general shape is as usual with these worms, an oblong, narrow at the mouth, wider at or about the middle of the body, and again narrowing before the clinging disc is reached. The mouth is distinctly terminal with thick lips, which are colored dark about the margins, in fact, this is the case throughout the whole body. The skin seems very dark from the presence of pigment. The pharynx, which is close up to the mouth, is bowl-shaped, and the external muscular fibres are directed around it, giving a rather ragged appearance. It is large and rather shallow, and is followed closely by the coeca or the intestines. These are wide and are soon lost in the vitellaria, which are very plentiful throughout the surface of the body, posteriorly quite to near the disc. A short distance posteriorly and between the coeca is seen the genital pore with a remarkably armed

cirrus and anterior to the opening. There seem to be three layers of hooks or spines, fourteen in the first layer, on the end of the cirrus, piled one on top of the other from a central point. The spines are long, and each is divided at its outer extremity or root into three or four filaments, all pointing posteriorly, or towards the body of the penis forming an unusually-shaped coronet. The vas deferens winds forward to form a seminal vesicle before reaching the genital pore. In the uterus near the genital pore, a relatively large round yellow egg occupies the distended organ. The surface of the egg is wrinkled from contraction. The ovary is small and elongated to about .40 mm. long by .10 mm. wide, and it is coiled upon itself on its way anteriorly. The egg is roundish and about .30 mm. in diameter. The testis is large, being .80 mm. in diameter. On the anterior surface of the ovary, a small seminal reservoir, or widening of the two vaginae at their junction, is seen, and from this point a tube leads to the oviduct. The shell gland can not be made out, nor is the uterus well defined, being distended out of all shape by the immense egg. The mouths of the vaginae may be seen among the vitellaria on each side opposite the genital pore. The vitellaria are unusually abundant throughout the body, rendering it difficult to trace the various organs. The vitelline ducts are plainly visible joining the oviduct. The clinging disc is rather irregularly shaped and supports six suckers. These are not quite like any others. They are surrounded on their margin by a flat, thick ring on which it is difficult to see the chitinous spines, they are so small. This whole ring seems to be lifted up from the structure below, making the sucker more deeply cupped. In the interior of the sucker, and surrounding its inner surface, there are a great number of small narrow finger-like processes, rods, or folds placed closely side by side and attached by their bases to the inner margin of the marginal flat ring, or else they may be attached to another ring just inside of the outer one. They are all directed towards the centre and are of about equal length, leaving the usual round hole in the centre or base of the sucker. They tend to keep the sucker in its concave shape and seem to terminate at another thickened ring which surrounds at a little distance the thin basal circular portion, and here is another marginal fringe of short free ends of folds which are somewhat like those in the central or concave portion of the sucker, only their inner or basal ends are free, and no doubt, their function is to close up the circular space and thus render the vacuum more perfect, for of course, it is in this way the suckers functionate under the influence of muscular fibres attached to the bottom of the sucker causing a vacuum. There is in the bottom of some of the suckers of this worm a small hook which is the only hook on the cotylophore. The flat marginal semi-elastic chitinous ring with its chitinous spines fixed on broad convex bases is without doubt, the foundation of these suckers in all polystomes. It keeps in shape the appliance ready at a moment's notice for attachment at the will of the worm.

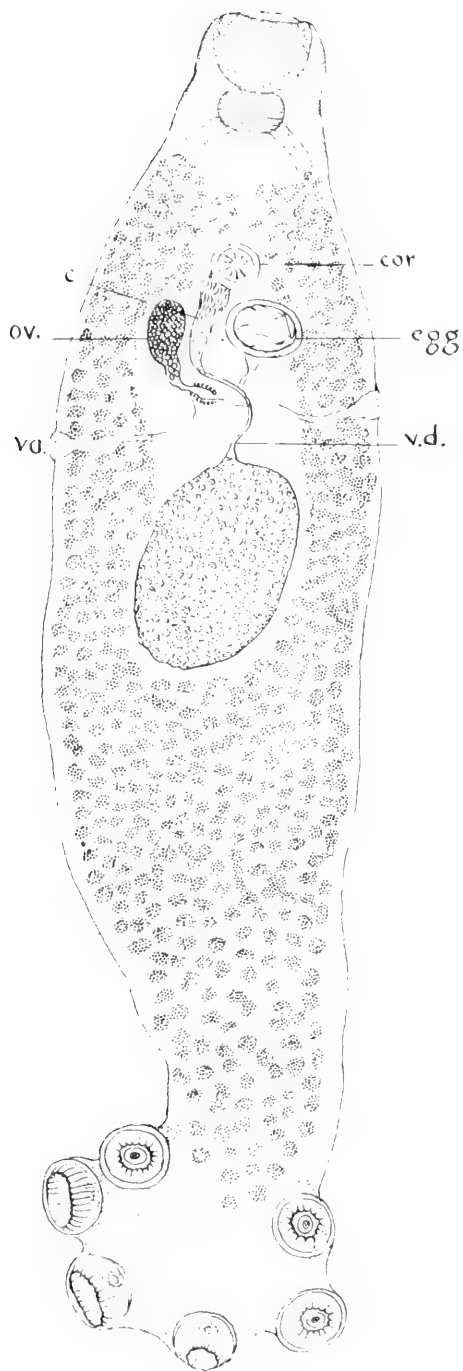


FIG. 52. *POLYSTOMUM* IRONSKI.

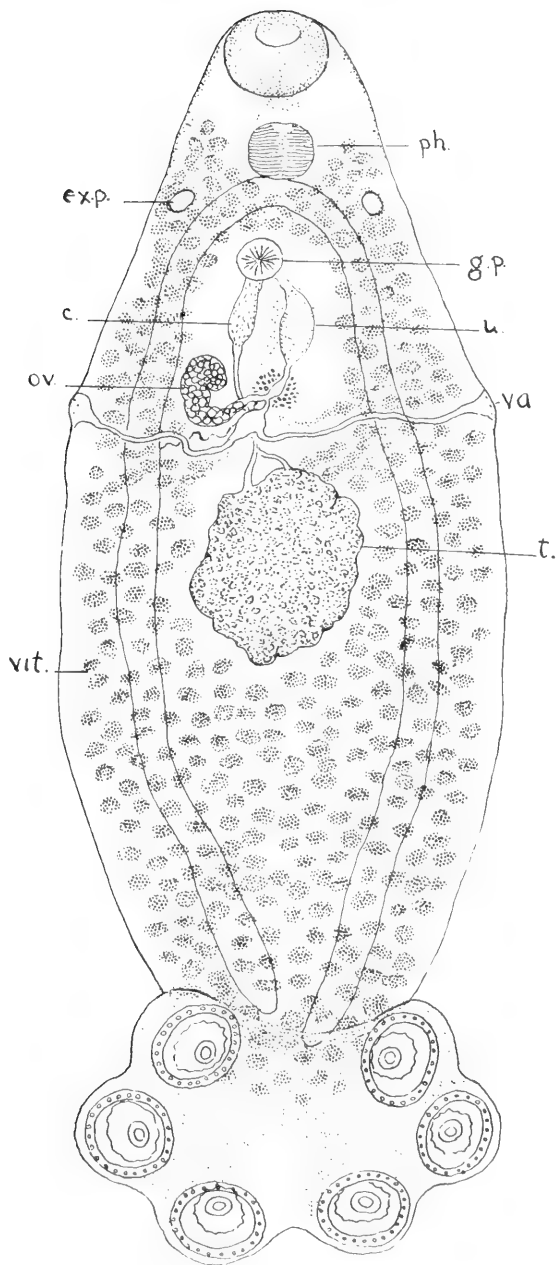


FIG. 53. *POLYSTOMUM FERNERME*.

The water vascular system terminates in two pores one on each side a little anterior to the genital pore.

Measurements of P. troosti

Length	4.00 mm.
Width	1.00 mm.
Diameter of disc80 mm.
Diameter of each sucker20 mm.

Polystoma inerme, sp. nov.

(Fig. 53)

Host—*Chrysemys elegans*.

Habitat—Urinary bladder.

Locality—New York Aquarium.

From the host, Cumberland turtle, *Chrysemys elegans*, I am able to describe what appear to be three new forms of polystomes; viz.: *P. elegans*, *P. albicollis*, and *P. inerme*. At first I thought this must be a record, but I find that Stunkard had also been able to describe three forms from a host *Chrysemys marginata*; viz.: *P. orbiculare*, *P. megacotyle*, and *P. microcotyle*. The third and last worm found in the urinary bladder of *Chrysemys elegans*, is not large, but quite interesting. It is quite pointed at the head, and presents at the posterior end a disc which is as wide as the widest part of the body. It is wider from side to side than it is deep, and presents on its surface six suckers, which are placed three at each side. The first two being a little farther apart than the two posterior ones. No hooks whatever, are seen, and the disc itself is separated from the body by a distinct line which gives the impression that the disc is raised above the posterior end of the body, but this may be only muscular, for all of the specimens do not show this. The mouth is circular and subterminal, as usual, and is a short distance from the pharynx which seems to be connected by a short oesophagus. The pharynx is a circular muscular bowl closely connected with the intestine, which divides into two long coeca reaching quite to the disc. The cirrus and uterus present at the genital pore. The coronet in the three specimens before me is differently supplied with hooks, there being 16, 17, and 15. This would go to show that the number of hooks on the coronet cannot be taken as a point of diagnosis for they often vary in number. The cirrus sac is large relatively and the uterus is a good-sized fusiform sac, both presenting at the genital pore. The ovary is situated on the right side in all these specimens, and here I may say that it has been my experience to find these internal organs uniform, in the same positions in the body, as one would expect. The ovary is not large, it is club-shaped, the large end near

the side of the body cavity, and the small end the oviduct. This is short in its connection with the uterus. There are two vaginae very plainly seen, and although the eminences on the sides are not high, yet they are there and a number of entrances can be made out. Where these vaginae meet near the oviduct, they enter a small sac, from which a tube enters the oviduct. Here too, may be seen the canalis genito intestinalis emptying into the intestine. Laurer's canal can not be unmistakably made out as usual. The vas deferens arises in this case by two distinct branches, which shortly unite. The ootype is plainly visible, as is also the shell gland. The testis is a single, large, roughly rounded organ situated in the middle of the body. The vitellaria are very profuse, and extend from the pharynx to half way across the disc. In fact, these glands so cover the body, that only the two outlets of the excretory systems may be seen. These are large, one on each side anterior to the genital pore.

Measurements of P. inerme

Length	4.00-5.40 mm.
Width	1.50-2.00 mm.
Disc, wide	2.00 mm.
Disc, deep	1.20 mm.
Head60 mm.
Each sucker40 mm.
Testis	1.00 mm.

Polystoma albicollis, sp. nov.

(Fig. 54)

In the urinary bladder of a Cumberland turtle, *Chrysemys elegans*, there were found on January 20, 1917, three polystomes, which I describe below in the belief that they are new; if not, then it is the fault of my reference, and it does not matter.

They are as usual in the genus, elongated with a powerful adhering disc, fortified, in this case, with long hooks thereon; two long ones and two shorter ones between the two middle posterior suckers.

The mouth is somewhat sub-terminal, large and communicates with the pharynx by a short oesophagus. In front of the pharynx, the head is marked by a light colored band, forming a sort of neck. This is caused by the absence, in that particular zone, of the unicellular bodies and other cells. The pharynx is almost globular, the muscular fibres of which run in a more or less circular direction, giving it great strength. Just behind, on each side of this body is a large opening, the excretory pore. The intestinal coeca divide at the posterior lower border of the pharynx, and proceed backward under or among the profuse vitellaria,

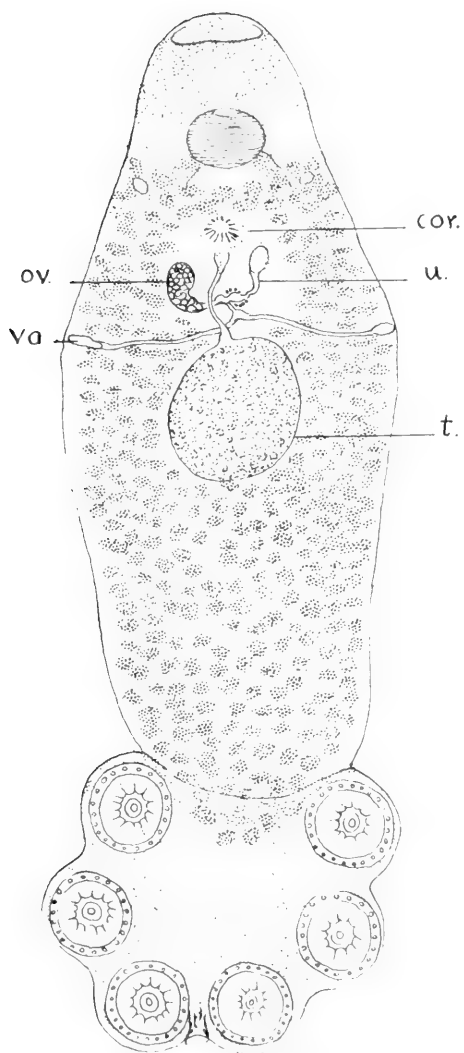


FIG. 53. *POLYSOMUS HERCYNICUS*

which extend from immediately posterior to the pharynx to the disc at the posterior end. The genital pore is a short distance behind the pharynx, and the very prominent head of the cirrus indicates its locality. This latter organ is profusely armed with thirty-four hooks or spines. These are long, clubbed at the inner end and forked at the external or marginal extremity or root. The cirrus sac is not so wide as in some instances. The number of hooks seems to vary in different specimens. One of the three specimens I have mounted has thirty-three, another thirty-four, and still another seventeen. Other than this, the worms seem identical. The uterus, back of and to the left of the genital pore, is a pear-shaped organ, base forward, and the posterior end receiving the oviduct. It can hold only one mature egg at a time. The ovary is somewhat bent upon itself, not large and lies behind and to the left of the uterus. It gives off the oviduct near its posterior end, and is there joined by a duct from the seminal reservoir, which in this case is present and is supplied from two vaginae, one from each side, the mouths of which are situated on an eminence on a level, a little in front of the anterior margin of the testis, and here, too at this same level, is seen the genital junction, where the vitelline ducts join the oviduct, just before it enters the ootype. This latter organ is surrounded by the shell gland. The testis is single, large, and round, giving off the vas deferens from its front margin. The vitellaria are very profuse covering almost the whole body.

The clinging disc is different from any described in this group. There are six suckers placed close together and not raised much above the surface of the body of the disc. The suckers are, however, deeply cupped and surrounded by the usual flat marginal ring, upon which are planted about forty spines. Internal to this end in the inner margin of the ring, or edge of the cup, it is scalloped by a narrow row of chitinous projections, completely encircling the margin, and beyond this towards the bottom of the cup, a membranous curtain, also largely scalloped, surrounds the cavity, and quite at the bottom is the usual circular opening, also surrounded by a second ring. In this case, too, between the terminal pair of suckers are four hooks, two of them quite long and strong, the other two straighter and more delicate. The larger ones extend just past the margin of the disc.

Measurement of P. albicollis

Length	5.00-5.40 mm.
Width	1.80 mm.
Disc	2.00 mm.
Anterior end40 mm.
Testis40 mm.
Length of hooks80 μ
Diameter of suckers40 - .45 mm.

Polystoma elegans, sp. nov.

(Fig. 55)

Host—*Chrysemys elegans*.

Habitat—Urinary bladder.

Locality—New York Aquarium.

On January 20, 1917, there was found in the urinary bladder of a Cumberland turtle, *Chrysemys elegans*, a polystome which appears to be a new species. It is somewhat larger than those usually found in the urinary bladder of turtles, measuring nine mm. in length by two mm. in width at its widest part which is across the portion of the body where the genital junction is situated. The diameter of the clinging disc is two and one-half mm. Across the mouth it is 60 μ . The mouth is sub-terminal and large, and presents apparently a small sucker on each side just within its margin. A short distance behind the mouth is the pharynx, which is fairly large. The intestinal ceca divide at once behind the pharynx, and in the angle formed is a mass of deeply-stained unicellular glands and a few masses of vitellaria.

Still further posteriorly is seen the coronet or armed end of the cirrus which is large and very prominent. The armature consists of a circle of hooks or spines, seventeen in number, which, at their outer extremity, are divided each into two or three small branches, in fact, in some there are six or eight branches, making each spine look like a miniature brush. These are the roots for muscular attachment. Each spine is 20 μ long and encloses a circular space. The whole end of the cirrus measures 75 μ in diameter. A very short distance posterior to this is the vesicula seminalis, which is pear-shaped or fusiform. The small end being directed posteriorly in the form of the vas deferens which is seen coming from the anterior end of the testis. Behind and to the left of the cirrus head is a relatively immense egg, which is yellow, roundish, and somewhat wrinkled; longest diameter, 120 μ . It seems to occupy the whole uterus, which in these worms is only capable of holding one egg at a time. Behind the uterus and to the left, is seen the ovary which is oblong, .60 mm. x .20 mm. and three times as long as it is wide. It is placed somewhat obliquely across the body and to its left, on the side of the worm, is seen the single prominence which indicates the presence of the many openings into the single vagina. The other vagina may be present but cannot be made out. The testis is an oval large body, 1.60 mm. long by .80 mm. wide. The vitellaria are exceedingly abundant, and present a general tube, almost surrounding the central portion of the body. Some of the vitelline masses extend into the sucker disc. The genital junction is situated between the ovary and the uterus, but no seminal reservoir or shell gland can be seen.

The sucker disc, 2.20 mm. in diameter, has on its surface six suckers which are different from those of other polystomes. They are cir-

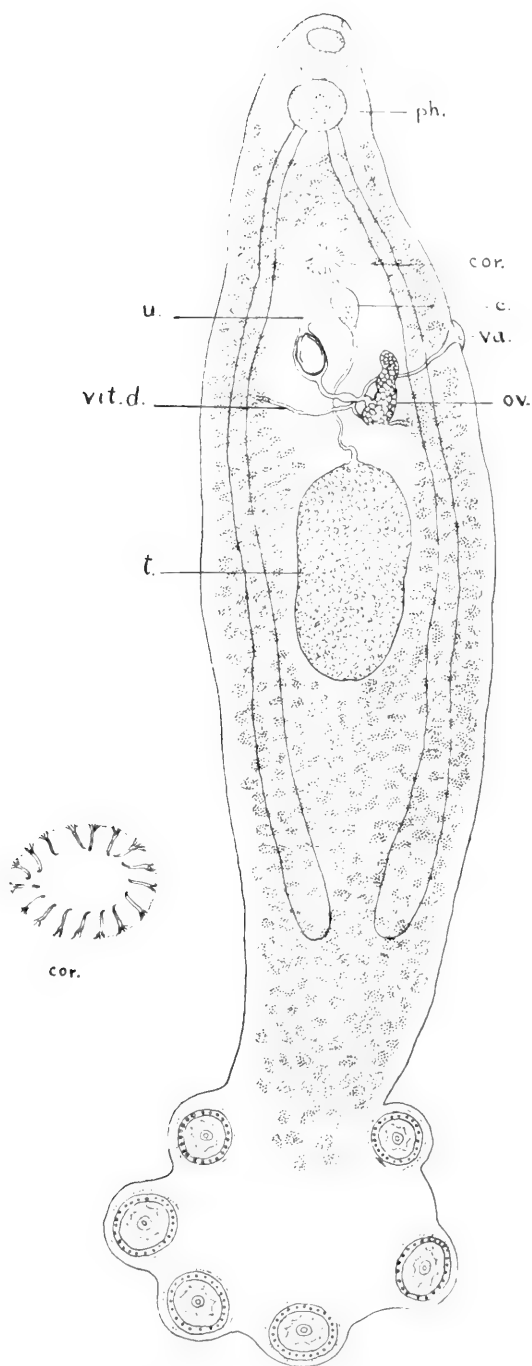


FIG. 55. *TOXISTOMYLIDINUS*

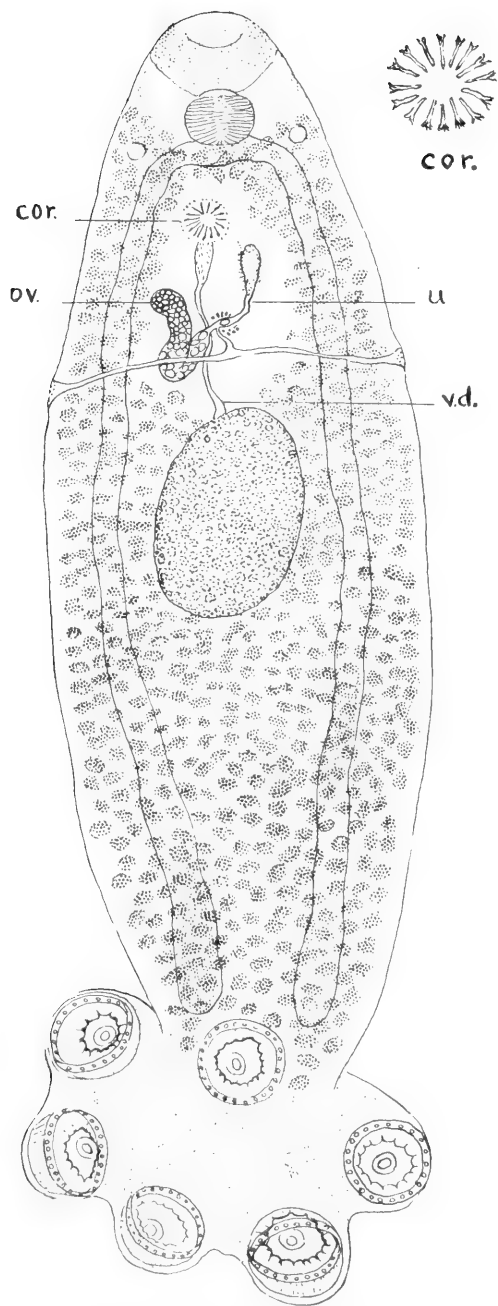


FIG. 86. *POLYSTOMUS SPINULOSUS*.

cular and deeply cupped, and are surrounded by the usual flat chitinous ring, on which, at equal distances from each other, are forty-eight little spines attached to the ring by a circular base, which is convex and much wider than the spine. In the centre of the bottom of the cup is a circular opening only covered by a membrane, and surrounding it is another thickened ring. Extending from the inner margin of the large outer chitinous ring is a membrane which extends toward the bottom, having its central margin irregularly torn as it were, not appearing in the forms of regular processes, as in some polystomes. The sucker disc is an irregular-shaped block, and the six suckers are placed well back from its margin. The suckers measure .40 mm. in diameter. There are no hooks whatever on the disc nor is there one in the bottom of the sucker.

Polystoma spinulosum, sp. nov.

(Fig. 56)

Host—*Chrysemys picta*.

Habitat—Urinary bladder.

Locality—New York Aquarium.

The above trematode was found in the urinary bladder of a painted turtle, *Chrysemys picta*, on December 18, 1912. As far as could be observed it was solitary. It has some peculiarities which others of this genus have not, so that it is thought proper to put it on record as a new species. The mouth is large and situated at the bottom of a terminal cup-shaped depression, the lips of which are rather thick. The oesophagus is not long and terminates in the usual bowl-shaped pharynx, which, in almost all of these worms, is the powerful suctorial apparatus. In front of the pharynx and surrounding the head of the worm is a ring, which is whiter than the rest of the region, giving it the appearance of having a sort of collar, which is conspicuous. The intestines start from the lower and back part of the pharynx and extend almost to the disc posteriorly. In the angle of the division of the coeca, the conspicuous head of the cirrus is seen, armed as usual with irregularly-shaped spines, or hooks, which are somewhat clubbed and split at their outer extremities or roots for muscular attachment. Behind this and almost in contact with it, is the pear-shaped uterus with the base toward the genital pore which is at the cirrus head. Toward the other side of the body, or the left side, is the ovary which is elongated and curved, and behind this is the single testis which is very large, perhaps four times as large as the ovary. From the anterior end of the testis is seen the vas deferens, which coils dorsal to the ovary and ends in a cirrus sac, which encloses the cirrus. From the left, lower side of the ovary, the oviduct arises and coils upward and forward to terminate in the uterus. In this case, the genital junction occurs dorsal to the pos-

terior end of the ovary, and the ootype and shell gland are plainly visible. There are two vaginae, which are situated one on each side, opposite the lower or posterior end of the ovary. They are both only large uneven openings and the vaginae meet from each side to connect with the oviduct. The vitelline ducts can not be made out, but they must also terminate near the same location. The vitellaria are very profuse and cover the most of the body from the pharynx to the disc.

The disc is an unusual structure. There are six suckers, each having on the surrounding, flat, chitinous ring about forty chitinous spines attached to a circular plaque, while between each pair, there are one or two hair-like bristles or spines, which would tend to give greater adhesive properties to the sucker. There is the usual small sucker disc at the bottom of each of the main suckers. There are many muscular bands which run from the disc up into the body of the worm, by which it may be controlled.

Measurements of P. spinulosum

Length	5.60 mm.
Width	1.80 mm.
Disc	2.00 mm.
Testis	1.00 mm.
Head40 mm.
Ovary40 mm.

Polystoma chelodinae, sp. nov.

(Fig. 57)

Host—*Chelodina longicollis*.

Habitat—Urinary bladder.

Locality—New York Zoological Park (from Australia).

This small trematode was found in the urinary bladder of a small long-necked turtle, *Chelodina longicollis*, Australia, and obtained from the New York Zoological Park.

There is nothing unusual about its conformation. The mouth is subterminal and the lip is unusually thick. The orifice in life was surrounded by numerous papillae, probably folds of the lip, which have disappeared under pressure. The pharynx is very large relatively, and the coeca divide at its back. These latter are large and extend almost to the posterior disc. The genital pore is situated some distance posterior to the division of the coeca, and is overhung by the cirrus head, which has a coronet of 15 hooks. The uterus is an oblong bag, presenting its mouth at the genital pore. The ovary is situated at the junction of the anterior and middle thirds of the body on the right side, and its oviduct first runs posteriorly until it meets the duct from

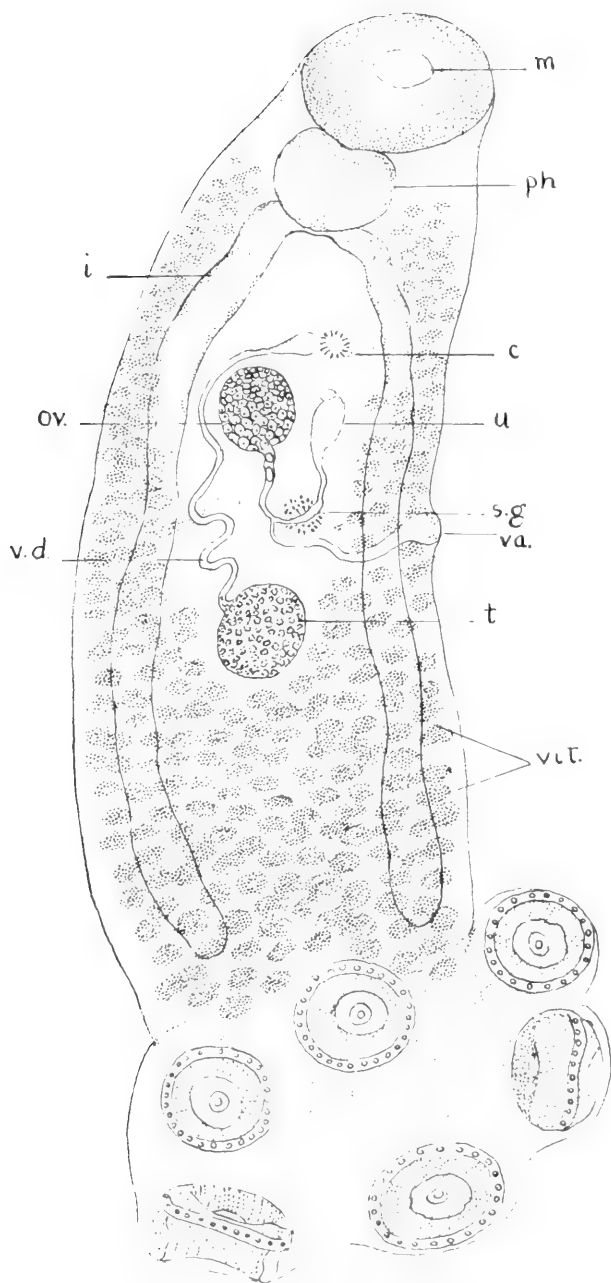


FIG. 57. POLYSTOMUM CHITONII.

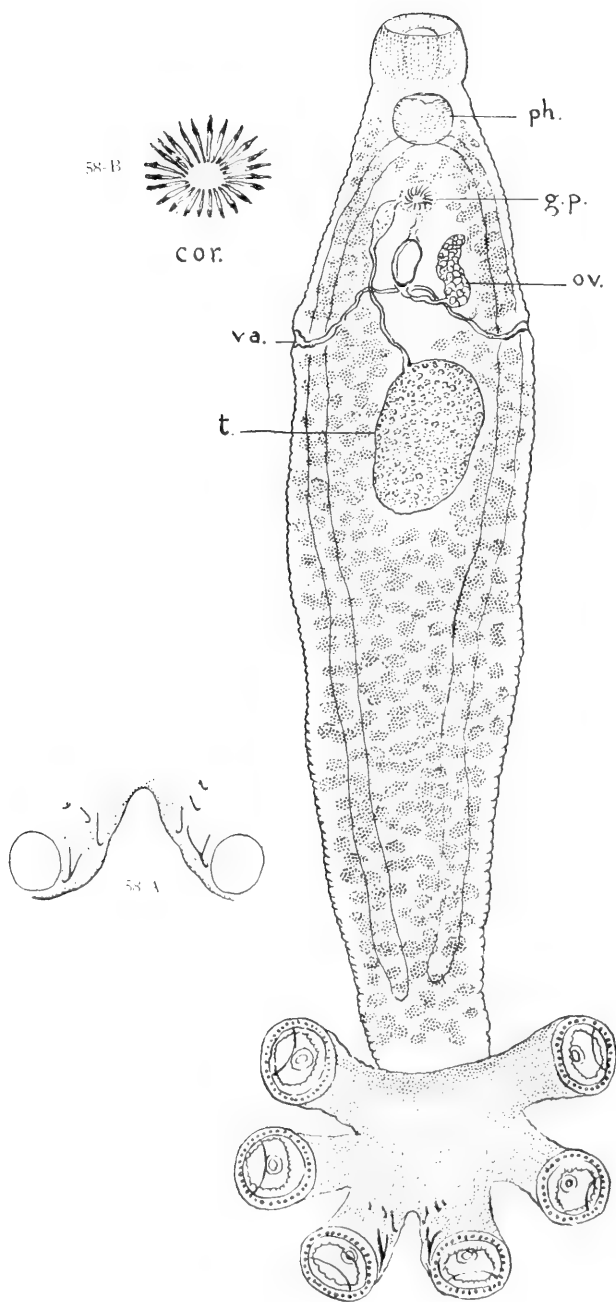


FIG. 58. *POLYSTOMA DIGITATUM*. FIG. 58-A. DETAIL OF HOOKS ON DISC.
 FIG. 58-B. CORONIT OF CIRRUS

the vagina, which opens about the middle of the left side on an eminence. No seminal reservoir is seen.

The testis is large and round. The vitellaria very plentiful. The clinging disc is short, but wide and extends beyond both sides of the body. It is not more than two-thirds as deep as it is wide, and the suckers are placed in two parallel lines across the diameter of the body. The suckers are large and apparently of the usual construction. There are no hooks whatever on its surface.

Measurements of P. chelodinae

Length	3.50 mm.
Width	1.00 mm.
Disc	1.15 mm.
Head across	60 μ
Testis	40 μ
Ovary	20 μ
Mouth across	30 μ
Pharynx	35 μ
Suckers	30 μ
Egg around	10 μ
Coronet	15 hooks

Polystoma digitatum, sp. nov.

(Fig. 58, 58a and 58b.)

Host—*Aspidonectes spinifer*.

Habitat—Nasal cavities.

Locality—New York Aquarium.

In the nasal cavities of a soft-shelled turtle, *Aspidonectes spinifer* (Le Sueur), there were found on February 5, 1913, three trematodes which, as far as I know, are of a new species.

The worm is not large, quite pointed at the head, but the most conspicuous feature is the relatively large posterior clinging sucker disc, which, as is very common with the *Polystomidae* bears six suckers. These latter are also peculiar, inasmuch as they differ from other species in being situated each at the end of a digit, while in others the sucker is placed directly on the surface of the disc block, each being deeply cupped.* In this species, the disc is something like that of the *Dictidophora*. The suckers themselves are quite different, for each is surrounded by the usual flat chitinous ring in which are placed a great

*This species has since also been found in a Southern soft-shelled turtle, *Trionyx ferox*; as many as fifty were found in the nostrils of one turtle. The specimens were larger.

number of chitinous spines equidistant from each other, and with a small hook in the base of each. Muscular strands, which control the suckers, can be seen extending up into the body. The enclosed cup-like cavity has a circular-covered opening at the bottom, but attached to the inner margin of the flat ring is a membrane which almost encloses the cavity, only a semi-circular opening being left at one side. The disc, itself, is marked off from the body by a ridge indicating the attachment, the body extending dorsally to the disc. The anterior end or mouth is cup-shaped with thick lips capable of extension. The mouth proper appearing at the bottom of the depressed portion. A gullet or oesophagus may be seen extending to the pharynx which is a bowl-shaped muscular structure, situated just posterior to what is a neck marked out by a narrow band or ring, which is almost devoid of the usual cells in the parenchyma which stain. The intestinal coeca are not very evident, being enclosed by the vitellaria and highly-colored stained tissues of the body. In the center of the body, within the angle of the ceca and a short distance posterior to the pharynx, is seen the prominent head of the cirrus surrounded by its armature of 31-35 spines. There are sometimes thirty-six of these spines, and they are of peculiar shape, being long and very slender at their base, but toward the outer extremity or root being much thickened by the divisions, which lie close to the center or stem and give attachment to muscular fibres. They, too, are directed outward and backward. The vas deferens which rises from the anterior end or side of the roundish single testis, winds up along the right side of the worm, just inside of the vitellaria to terminate in a cirrus sac, in which the cirrus is enclosed up to the edge of the genital opening. The uterus, a more or less pear-shaped, hollow structure with the mouth at the base directed forward toward the genital pore, is not large and receives the coiling oviduct from the ovary. This is not long, but is seen to receive the vagina and also the vitelline ducts. No shell gland can be made out, nor is there a seminal reservoir to be seen in the course of either of the vaginae. The genital junction is plainly seen between the anterior end of the testis and the ovary a short distance in front of it. The testis is round and about three times as large as the ovary. The vaginae open on each side of the body, a little in advance of the level of the anterior edge of the testis. The vaginal orifice is a large corrugated single opening without any prominence on the surface of the skin. The vaginae can be seen making their way to join the oviduct. This is perhaps unusual, but is certainly present.

For classification, worm is elongated, skin thick and corrugated. The vaginae not arising on eminence on each side, large clinging disc with each sucker placed on a digit.

Measurements of Polystoma digitatum

Length	4.00 mm.
Width80 mm.

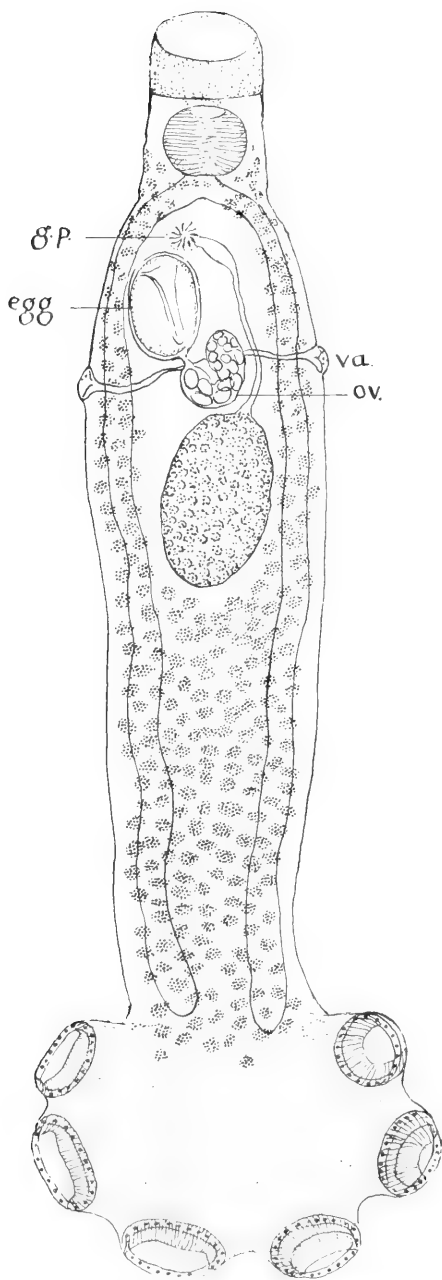


FIG. 89. POLYSTOMUM ASPIDONECTIS.

Disc	1.40 mm.
Testis60 mm.
Ovary30 mm.
Pharynx20 mm.
Length of digit (including sucker)40 mm.
Diameter of sucker30 mm.

Polystoma aspidonectis, sp. nov.

(Fig. 59)

Host—*Trionyx ferox*.

Habitat—Nasal cavities, lung and intestines.

Locality—New York Aquarium.

On May 10, 1916, these trematodes, of which there were collected five from the same host; four were from the intestine and one from the lung. From the same host, soft-shelled turtle, *Trionyx ferox*, there were also collected from the nasal cavities four larger forms which I have ventured to name *P. rugosa* for the reason given in its description. It seems rather odd that while these worms are usually found in the nasal cavities or urinary bladder, they were in the case of *P. aspidonectis* found in the intestine and lung and not in the nostrils, although they might easily have wandered away from the natural habitat, if they were not driven away by *P. rugosa*.

P. aspidonectis, as will be seen by the measurements, is small, probably one of the smallest polystomes yet observed. To prove that they are adults, one has only to notice the relatively immense egg which distends the uterus, apparently to its fullest capacity. The mouth is rather large and more or less terminal, and round in shape. The pharynx is but a short distance posterior to the mouth, and is bowl shaped, almost round, and the intestinal ceca seem to be given off at once. Their course, however, can not be seen or followed on account of the vitellaria and dense cellular structure in this region. In the centre of the body, and a short distance posterior is seen the very prominent armed head of the cirrus. It has seventeen rather long spines, which concentrate from outward and backward. Each spine is branched at its outer extremity, and the whole number are piled on one another and are somewhat tangled together. The vas deferens, which leads from the anterior surface of the large oval single testis, passes dorsal to the uterus containing the egg. The uterus which is situated immediately behind the cirrus head, where presumably the genital pore is, cannot well be made out, for it can only contain one egg at a time and is distended to such a thin sac that it can not be seen, although the oviduct may be seen leading up to it from the ovary.

The ovary is rather small, situated in front of and to the left of the testis and about one-quarter or one-third of its size. On each side of the worm and almost on a level with the anterior edge of the ovary, may be seen the raised openings of the vaginae. These lead backward and inward to join the oviduct, but no dilatation indicating a seminal reservoir can be seen. The vitelaria are plentiful along the sides of the worm, and the vitelline ducts can be seen proceeding to join the oviduct between the testis and the ovary, where is situated the genital junction. The disc is the most prominent feature of the body, situated at the posterior end, it is a more or less quadrangular block, on which are placed six suckers of peculiar formation. They are cup-shaped as usual, surrounded on their margins by a flat chitinous ring, upon which may be seen thirty-two spines, placed at equal distances from each other around the whole circumference, and between each pair of spines, there appears in some cases quite plainly a Y-shaped hook. This may not be certain, on account of the material at hand, but the appearance is strongly suggested. Inside the sucker at its bottom, is a circular-covered hole as usual, which is surrounded by a membrane in folds, the outer margin of which is attached to the marginal chitinous ring. No large hooks are seen on the disc as in the *P. integerrimum*, but there is a small one at the base of each sucker.

For the purpose of classification, the body may be said to be long, narrow and straight; cirrus with an armature of seventeen hooks, two vaginae, egg almost oval, large, and yellow.

Measurements of P. aspidonectis

Length	2.60 mm.
Width40 mm.
Disc80 mm.
Egg20 mm.
Testis60 mm.
Ovary20 mm.

Polystoma rugosa, sp. nov.

(Fig. 60)

Host—*Trionyx ferox*.

Habitat—Nostrils.

Locality—New York Aquarium.

Obtained from the nostrils of a Southern soft-shelled turtle, *Trionyx ferox*, on May 10, 1916. This *Polystoma* is small, short, and rather broad, anterior end wide in proportion to length, however, the four specimens under observation have all a peculiar corrugated skin. In fact, the skin appears thick and is thrown into more or less transverse folds which extend from the neck to the sucker disc, giving the

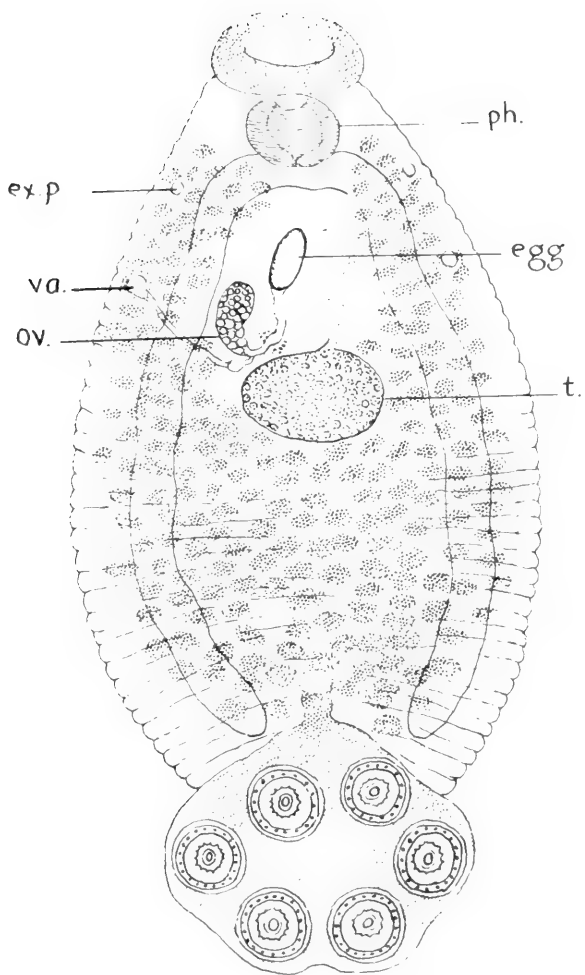


FIG. 60. *POLYSTOMUM RUFOSUM*

impression that the whole body may be capable of great extension. They were found in the nostrils of their host.

The mouth is large and terminal with the bowl-shaped circular pharynx close to it, in fact, immediately posterior to the mouth and apparently, but a continuation of the same. The dorsal edge of the mouth or lip is very prominent. There is but the shortest possible neck. The pharynx is almost as wide as the mouth and posteriorly it empties immediately into the intestine, there being no oesophagus. The intestine branches almost immediately behind the pharynx, which indeed may be said to enter the intestine. This latter structure is very wide and extends in a wide arch to each side, and proceeds posteriorly to the anterior margin of the sucker disc on each side, but does not seem to be continuous, although the cecal ends come closely together. Between these ends, and a little anterior to them may be seen a large opening, the excretory pore, the posterior edge of which seems to be connected with the disc by a rather wide band. This band-like structure may be a wide tube, which plainly appears to connect with the base of each of the first suckers. The edges of this tube are also corrugated. The disc is a more or less quadrangular body with six cup-shaped suckers, so placed that there are two side-by-side next to the body, and four others, situated around the edges of the distal margin. They are of an equal size and are circular. Around the margin of each, which is in the form of a flat chitinous ring, there are about thirty-two small spines, each set on a small chitinous plaque on the margin of the ring. Inside of this is another ring, to which is attached, what appears to be a membrane with fibrous striae radiating from its outer margin, forming an opening in the center, and in the center of this and of the sucker is a round-covered opening which is again surrounded with a thickened margin. The whole disc is seen to be surrounded by a narrow membranous edge. Within the arch of the intestines is the genital aperture, where the mouth of the uterus is seen, and in one case there is present a large, yellow, fusiform egg without any polar filaments. Behind the genital pore is the large, single, more or less oval testis, placed directly across the body. The ovary is small and oblong, and is situated in front of and to the right of the testis, lengthwise of the body. The uterus is a more or less conical sac, capable of holding one egg at a time. Cirrus has no coronet, at least it is not seen in any of the specimens.

On each side, a little posterior to the level of the genital pore may be seen the vaginal orifice, a rather large, round, open pore, and in front of these on each side an excretory pore. The vitellaria are quite plentiful, extending in golden-colored masses throughout most of the surface of the body. No hooks are seen between the two central posterior suckers or elsewhere in many specimens of this worm examined.

On further study of these worms, I would say that until more material can be obtained so that the body may be sectioned, there are some

points which ca not be cleared up. For instance, no cirrus or coronet can be seen in any of the four worms, one worm being spoiled and another so thickly studded with escaped vitelline material that the internal organs cannot be studied. In the remaining two worms, which are perfect specimens, the uterus is occupied with a very large oblong egg obscuring the genital pore in one case, and the very large testis in each almost covers the entire field in this important region. Then it must be said that the corrugated skin extends across the body, in coarse ridges and at the junction of the disc with the body, a deep groove seems to almost separate it from the body, although the mentioned wide band or duct from what appears to be a large excretory pore is not affected, but plainly retains its position.

Measurements of P. rugosa

Length	4.00 mm.
Width	2.00 mm.
Width of disc	1.40 mm.
Width of mouth end40 mm.
Egg length40 mm.
Egg width20 mm.
Testis length60 mm.
Testis width30 mm.
Ovary length20 mm.
Ovary width15 mm.
Diameter of suckers on disc	40 μ
Width of mouth	30 μ
Width of pharynx	45 μ

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ZOOPATHOLOGICA

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VOLUME I, NUMBER 5

NOTES ON THE GENUS CAMALLANUS AND OTHER NEMATODES FROM VARIOUS HOSTS

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Thanks are also due to Dr. W. G. MacCallum for several unique and new forms collected by him during his trip to the Orient.

Mr. A. Feinberg, artist, is also deserving of my sincere thanks for his patience and skill in preparing the plates.

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ABBREVIATIONS

Abbreviations in explanation of plates:

a.—anus	o.s.—oral sucker
b.c.—buccal sucker	ov.—ovary
b.—bursa	oot.—ootype
b.e.j.—bulbus ejaculatorius	oe.—oesophagus
c.s.—caudal sucker	ov.d.—oviduct
c.s.—cirrus sac	oes.g.—oesophageal gland
c.p.—cirrus pouch	ph.—pharynx
cl.—cloaca or genital pore	p.p.—pars prostatica
ce.—coeca.	pr.—prostate
cor.—coronet	p.—papillae post and preanal
c.—cirrus	res.—reservoir
c.gl.—cement glands	s.g.—shell gland
d.e.j.—Ductus ejaculatorius	s.v.—seminal vesicle or vesicula seminalis
e.—eye	s.r.—seminal reservoir
ex.p.—excretory pore	sp.—spicule
ex.v.—excretory vessels	t.—testis
g.i.c.—genito intestinal canal	tr.—tridents
g.p.—genital pore	u.—uterus
h.—hook.	u.g.—unicellular glands
i.—intestine	v.d.—vas deferens
li.—ligament	va.—vagina
le.—lemnisci	vit.—vitellaria
l.c.—Laurers canal	vit.d.—vitelline duct
m.—mouth	v.s.—ventral sucker or acetabulum
m.b.—muscular bands	w.v.s.—water vascular system
m.g.—mucus glands	y.d.—yolk duct
met.—metraterm	y.r.—yolk reservoir

NOTES ON THE GENUS CAMALLANUS AND OTHER NEMATODES FROM VARIOUS HOSTS

Parasitic nematodes are by far among the most important parasites affecting human welfare and disease. When we consider their prevalence in domestic animals, and fish which constitute the most important article of human food, not to speak of their parasitism in vegetable food stuffs, we are easily led to see their importance in the economy and welfare of mankind. It is consequently remarkable how little they and their influence have been studied, even from an economic point of view. The field is so large and so comparatively unworked, that it is difficult to decide where to continue the study. Within a short time the writer has met with a form of nematode, which has been but little noticed on this continent, in fact the only reference known is one made by Prof. H. B. Ward in a contribution from the Zool. Lab. of the University of Ill., No. 78, 1916, in which he describes very generally the occurrence of two new species of *Camallanus* under the names *C. oxycephalus* and *C. ancylodirus*. Railliet and Henry in 1915 took up the study of these parasites in Europe and established for them a new genus. Hitherto, while they had been observed, no definite effort other than as given above had been made to give them a standing in the biological world. Dr. Ward claims that his two species, one found in a German Carp and the other two in a white bass and a black Crappie, all hosts from Iowa, are the first described in America, and from the general tenor of his paper one would infer that the worm was rare. I am glad to give my experience with this parasite, which I think will indicate that it is anything but rare, and this I do in a few short notes as possible. I may premise by saying that for the last seven or eight years the Director of the New York Aquarium has kindly placed a large amount of material at my disposal, which was collected from distant points in America. Other sources also have been made available.

The genus *Camallanus* is a haematophagic nematode whose habits appear to be those of the *Strongylidae*, in fact it would appear that it should belong to a sub-family of that genus, instead of being established as a separate genus. They live in the same organs, have identical habits and attach themselves to the mucous membranes in the same manner as is done by the *Strongylidae*. They have a muscular pharynx or upper part of the oesophagus which enables them to suck the blood from the mucous membrane after it has been wounded by the peculiar

structure of their mouths, which is a hollow surface with long sharp ribs or knives, which can be brought together much as the hookworm does with its sucking apparatus, not excepting the buccal sacs which may be slightly different in shape, but identical in function. Beside this, they are probably more fertile than hookworms, since the whole body of the female is a distended sac of living larvae and eggs, and the females are about fifteen or twenty times as plentiful as the males.

The adult worm is red and varies in length from 15 mm. to 25 mm., and in width about .25 to .30 μ . The body is very delicately formed, gradually tapering to the posterior end where the tip is generally trifid. The female is much larger than the male, and as a rule the shoulders of the female are much more angular or square than in the case of the male. However this may not hold in all cases, but it seems to be the rule. The vulva is situated on the ventral surface very near the middle of the worm. It is usually very prominent and swollen into two lips as shown in Fig. . . The head, however, is the most prominent feature, and unlike that of the hookworm, is a very ornamental structure. It is chiefly composed of chitin and is shell-like in shape, being quite concave with six main ribs on each side of the central line, which converge toward the throat. There are also a few short ribs which help to give this part of the mouth at its back a hollow fan-shaped appearance. On each side of this formation is a very decided concave portion, which answers to the buccal capsule of the hookworm. In action the mouth seems capable of closing from each side, while the sharp-pointed rods make a wound in the mucous membrane, or one side crosses behind the other as in a pair of hair clippers. The powerful muscular pharynx or oesophagus, exactly like that of the strongylidae, then performs its sucking action. The whole head of the worm is often found buried in the mucous membrane, but it may be easily detached. The whole head, including when present the two or three lateral pendants, called by Ward "tridents" is composed of amber-colored chitin and across the throat is a straight band of the same material. The neck is straight. There is also on each side on the dorsal surface of the ribs or knives a bar of chitin across the anterior ends of the median four of each half, for the purpose, possibly of stiffening them. Usually, there are five or six long ribs which reach from the anterior lip and converge in the throat, and between them at their anterior ends are two short ribs on each side of the median line. The two central ones are short and very like sharp teeth. The extreme margin of the head is bounded by transparent material with three considerable nodules, one on each side and a small one in the middle. The anterior end of the oesophagus extends quite to the throat. The length of the muscular portion of the oesophagus is usually about 55 μ , width at the widest part 20 μ . It is bottle shaped. The second part of the oesophagus is 90 μ long and generally the outside is ragged. The protruded flaps of the vulva of the gravid worm measure 35 μ x 15 μ . The mouth of the vagina is 5 μ wide. Across the head 20 μ , across the shoulders

40 μ , across the mouth, which is always patent 15 μ , and length of the "tridents" 10 μ . Across the gravid uterus 40 μ . Anus is within 40 μ of the tip usually. No doubt these worms vary in size in different hosts, but the above measurements are those of a full-sized gravid female. The uterus usually contains both larvae and eggs, but the former are in thousands. They measure 20 μ long x 2 μ wide. The male is a small worm beside the female, where the females are 20 or 25 mm. long the males average 10 to 15 mm., and about half the width of the female. The posterior end of the male is usually coiled, and two white cirri may be seen protruding or within the body. They are about 50 μ long and equal in length. There are three pairs of post anal papillae, and one pair of preanal. These are not easily seen for the tail is so closely coiled. Near the anus, probably on each side of it, is a semi-circular flap, which acts like a bursa in the bursated nematodes. In all these worms there are to be seen the head glands as described by Looss in his paper in 1901. "The Sclerostomidae of Horses and Donkeys in Egypt" (Rec. Govt. Med. School, Cairo). The skin is finely striated.

Camallanus oxycephalus, Ward.

Locality—New York Aquarium.

On November 4, 1917, in the stomach of a Mississippi alligator, there was found an adult female specimen of this species *Camallanus oxycephalus* (Ward).* The general description given will answer in this case, except that near the anus there is a constriction in the bowel, opposite which on the outside of the gut on each side there is a tag like process both pointing toward the tail.

Camallanus scabrae, sp. nov.

(Fig. 61)

On December 14, 1917, there were found in the intestine of a *Chrysemys scabra* and six collected, two males and four females, of these worms. More could have been recovered if necessary. They possess no peculiarity beyond the general description, except that perhaps they were somewhat smaller.

Locality—New York Zoological Park.

On December 21, 1917, there were found in the intestines and stomach of a *Chrysemys scabra* a great number, in fact there were hundreds of the worms, many of them still clinging fast to the mucous membranes. Proportion of males about two to ten females. Females about 20 mm. long. Males about 15 mm. long. They have a peculiar

*"The Journal of Parasitology," Vol. III, No. 2, Dec., 1916.

bursa. Two post anal papillae and six preanal papillae. They have two prominent spicules.

Locality—New York Zoological Park.
also

On June 25, 1916, there was found in a *Chrysemys picta* an adult, gravid female *Camallanus scabra*. This one also shows the anal valve. Head glands, very distinct. No peculiarity. Size about 20 mm. long.

Locality—Woods Hole, Mass.

Camallanus troosti, nov. sp.

On May 25, 1916, there were found in the intestines of a Troost's terrapin, *Chrysemys troosti*, a lot of large *Camallanus* worms, six females and one male were collected and mounted. The male presented about 20 μ in advance of the anus a bottle-shaped cyst 10 μ x 8 μ , on the outside, and from it a tube extended into the body, evidently a part of the bursal sac. The cirri presented at the anal opening. Three pairs post anal and one pair pre-anal papillae seen. From the above-mentioned cyst or bursa the skin is raised 5 μ , all the way to the tip of the worm. No other peculiarity, and this may be only the usual male sexual end, such as I never saw before.

Locality—New York Aquarium.

Camallanus chelydrae

On March 17, 1915, there were collected eighteen *Camallanus* worms from the intestine of a *Chelydra serpentina*. There is no appreciable difference between these and the general description. They were all females and the intestine is filled with black material, partially digested blood.

Locality—New York Aquarium.

Camallanus floridianae, nov. sp.

(Fig. 62)

On June 20, 1916, on examining a Florida diamond-backed terrapin, *Chrysemys floridiana*, there were found in the stomach a number of *Camallani*, which, because of some difference between them and the other members of the genus, I propose the name *Camallanus floridianae*. There were collected and mounted three females and two males. The mouth has a different arrangement of the rods or knives. In most of these worms these rods are placed on two levels, one set of four being in front and the other set of four placed behind, and diagonally across the first. Whether this condition is only an exemplification of

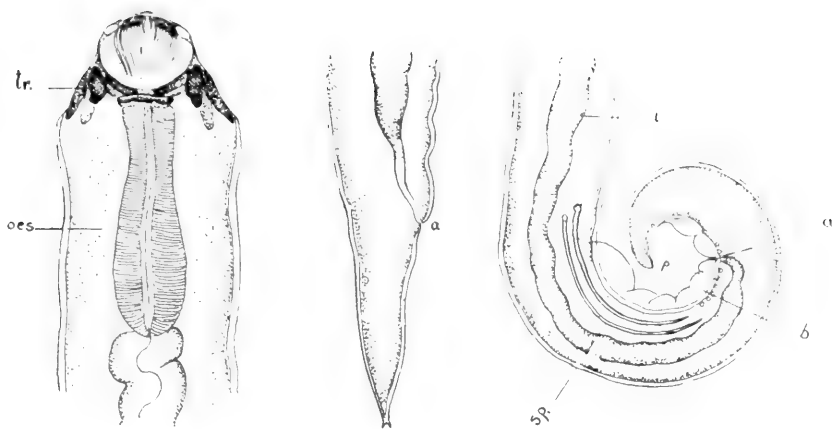


FIG. 61. *CAMALLANUS SCHUBERTII*.



FIG. 62. *CAMALLANUS FLORIDENSIS*.

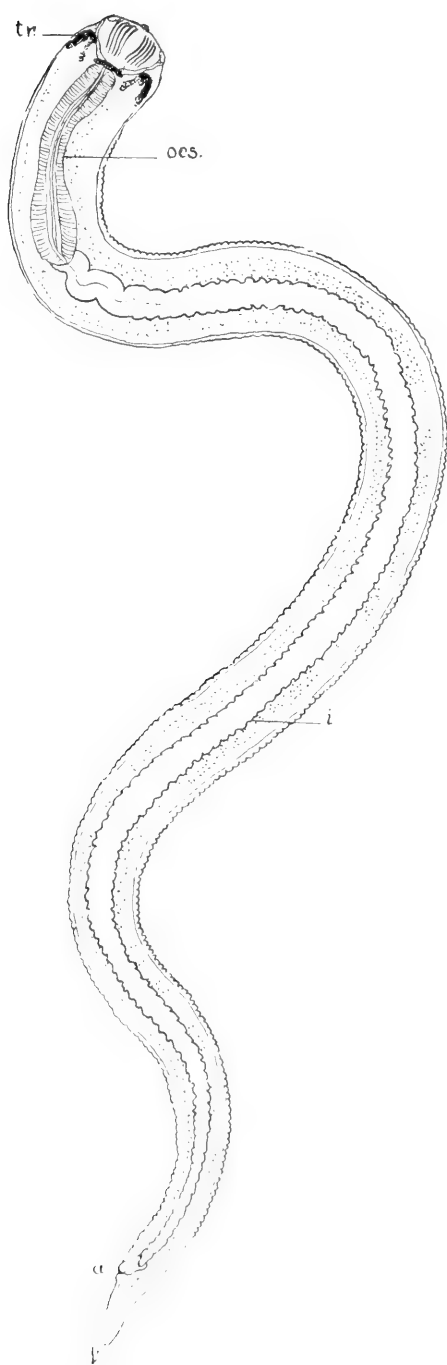


FIG. 68. *CAMALLANUS PSYCHOOZONDIS*.

the way in which they act normally by a sawing motion, I do not know but, this would look reasonable. They may act like a pair of hair clippers and were caught in this position when death took place. The mouth is, if anything, more concave than usual and there appear to be only two shoulder straps of chitin on each side of the neck instead of three, and in that case they would cease to be "tridents." They are not teeth anyway, Fig. 62. The males are uncoiled so that a sketch of that portion of the body was possible and revealed the fact that there are three post anal and six pre-anal papillae. They were all very long, especially the pre-anal ones, which are 7μ long and each with a knob at the end. The cirri were white and seen protruding a short distance. See bursa also Fig. 62. The larvae were not so plentiful, but seemed large, measuring 20μ long and 2μ wide. Seemed larger than in other worms.

Female—15 mm. long.

Male—7 mm. long.

Locality—New York Aquarium. Florida.

Camallanus elegans, sp. nov.

These worms were found in and collected from the stomach of Cumberland turtle, *Chrysemys elegans*. They were a lot of small red worms and several were mounted, 3 females and 3 males on one slide, and 4 females and 2 males on another. They measure about 15 mm. and 7 mm. respectively and the only difference to be seen from the general description is that the males which in two instances are uncoiled show a formidable looking single cirrus, which is thick and sharp, and the whole length is 90μ with about 7μ protruding in one case and 30μ in the other. The papillae are the same in number, but of a different shape from those described for *C. floridianae*. In this worm they are lower and thicker. This is the only cirrus I have seen protruded and while I thought that I could see the points of the two at the outlet in others, still I may have been mistaken, although I think not for they could be seen in the body. The bursal arrangement in this worm is quite different from any other. There is a sac not so divided and the whole affair is not so complete and pretentious as in *C. floridianae*. The host was kindly sent from the New York Aquarium and came originally from Florida. I propose the name *C. elegans* for it.

Camallanus ptychozoondis, sp. nov.

(Fig. 63)

On May 24, 1916, there were found in the rectum of a *Ptychozoon hemaloccephalum* a leaf-like lizard taken near Buitenzorg, Java, a few *Oxyuridae*, and one small *Camallanus*. A description of the latter

follows. It is provided with a head and mouth, in shape somewhat like the concave side of a scallop shell. This part of it is yellow or brownish chitinous material concentrating posteriorly into a throat which is the beginning of the pharynx. This latter organ is flask-like in shape, so common in this genus, and is quite muscular. The intestine follows and finds its outlet on the left side of the worm near the end of the tail which is pointed and chitinous.

The vagina has not been seen, but appears to be very near the mouth on the left side and from this extends to the uterus, which is tubular and contains numerous round eggs. The worm is only about 5 mm. long and .20 mm. wide.

Camallanus cyathocephalus, sp. nov.

(Fig. 64)

Host—*Chrysemys scabra*.

Habitat—Stomach.

Locality—Zoological Park, New York.

While examining a slider terrapin, *Chrysemys scabra*, among some other *Camallanus* worms, I found one quite different from the others, as will be seen by a reference to the plate.

It is an immature female, that is, it has no eggs in its uterus, yet otherwise it is perfect. The head is the peculiar feature, since it is different from the ordinary *Camallanus*, having no "tridents" or adornments on the outside of the head. The whole structure gives the impression of a likeness to a wine-glass or goblet. The mouth is like that of the genus as far as shape and incising rods are concerned, yet it is vastly more delicate and proves a difficult task for an artist to portray and do it justice. It is composed of the usual amber-colored chitin. The worm is only 5 mm. long. The tail is trifid.

Camallanus bungari, sp. nov.

(Fig. 65)

On May 26, 1916, there were found in a Krait, *Bungarus candidus*, at Buitenzorg, Java, a small *Camallanus*, which probably hitherto has not been recorded. It has a wide open mouth as usual in the genus, which is sub-terminal, the real mouth, however, seems to be a circular opening near the center of the anterior margin of the round, amber-colored, chitinous structure, which lies open at the anterior end of the worm. From the small circular mouth, a tube, the oesophagus, leads into the pharynx. The open circular chitinous structure has within its outer margin two circular rings, which concentrate at the opening of the pharynx. The outer one of these is armed with very small spi-



FIG. 64. GAMMARINUS OITHROPTERUS.



FIG. 65. GAMMARINUS BENEDICTI.



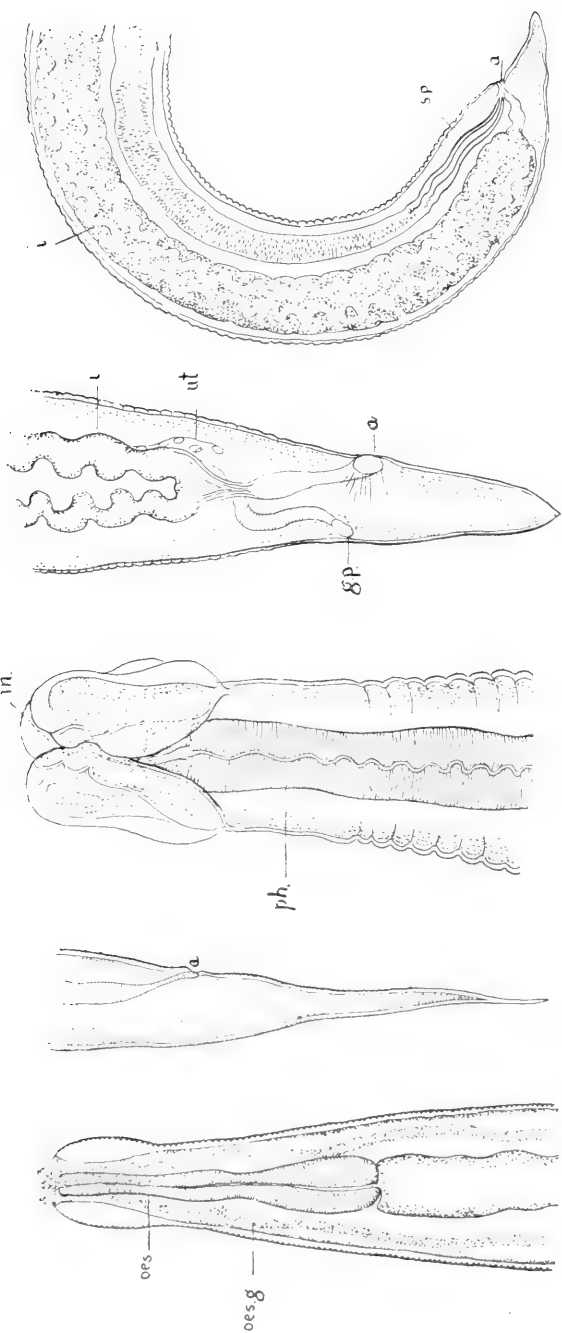


FIG. 65. *ASCARIS OGCOCEPHALI*.

FIG. 66. *STRONGYLUS SIMIAE*.

cles or teeth, and the more or less circular anterior margin of the pharynx is also armed with small teeth. The pharynx is as usual flask-shaped and quite muscular. It terminates in the intestine and this latter has its outlet, in this case, near the posterior spiked tail. It is next to impossible to follow the windings of the genital apparatus in the body of this female worm, but it is almost certain that the genital opening is at the junction of middle and posterior thirds of the body. No other opening is seen. There is a tube which can be traced nearly to the anterior end of the worm, but it is undecided whether a vagina may be there. Tail trifid, while only three rods can be made out in this species, there is also a membrane which encircles the mouth being attached to its margin all around.

Strongylus simiae

(Fig. 66)

Host—*Simia satyrus*.

Habitat—Colon.

Locality—Singapore.

On July 21, 1916, while examining one of these animals, Dr. W. G. MacCallum came across several small nematodes in the colon, and saved them. They consist chiefly of Oxyurides, probably *Oxyuris vermicularis bremscr* (*Ascaris vermicularis* Lin.), Diesing Syst. Helm. 11, p. 144-145. These worms are quite small, 6 or 7 mm. long by .40 wide and very sharp or pointed at each end, body filled with small eggs. Among these, however, I discovered three or four other worms which are strongyles and may be *Strongylus longivaginus*, Diesing Syst. Helm. 11, p. 877-878 ventric. The only other strongyle known for this animal, according to Von Linstow, is *Strongylus duodenalis* Dubini, *Uncinaria duodenalis* Railliet, 1885, the same as in man. Of course, these are well known, but *S. longivaginus*, I am not familiar with.

These strongyles, a figure of which is given, are small, all four females and filled with eggs. They measure 20 mm. long by .90 mm. wide. The body is prolonged into a very sharp tail and the skin is striated transversely throughout, although the striations are very delicate and hardly perceptible. The skin is also armed with fine denticles throughout, all pointing backwards. The head is 10 μ across, but immediately behind the mouth the skin on each side spreads out so that it measures across this part 20 μ . The mouth is armed with six small hooks. These with the enlargement behind the head enables the worms to retain its hold, when the head is buried beneath the mucous membrane of its host. The mouth is followed by a relatively long oesophagus, which is very muscular and is the sucking apparatus. On each side of the oesophagus, there is an oesophageal gland, or tube, which is said to convey poisonous matter into the tissues of the host. The

anus is situated about 200μ from the tip of the tail. The vulva is at the junction of the anterior and middle thirds of the length of the worm. Eggs 5μ long and 2μ wide. No males seen.

Ascaris ogcocephali, sp. nov.

(Figs. 67 and 67a)

On examining a bat-fish, Diabolo, *Ogcocephalus radiatus* (Mitchill, 1818), on April 18, 1917, from Key West, Florida, there were found a large number of ascarides in the small intestine and stomach.

The female worm is much larger than the male, and it is yellowish in color, while the male is quite small and whitish. They both are quite pointed at the extremities, especially the posterior, and the tail of the male is incurved. At the anus, which is very near the tip, may be seen three pairs of papillae post-anal and two pairs pre-anal. The cirri were not seen protruding, but could be seen internally. Along the dorsal portion of the abdominal cavity, there were a number of conical masses, which extend in two rows from a point near the middle of the worm to the posterior end.* The intestine, filled with dark-colored matter, extends from the oesophagus along the middle of the body to the anus. The oesophagus is long and muscular, and at its junction with the intestines may be seen two long coeca, one pointing posteriorly and the other recurved anteriorly. The head end is unlike that of any of the other ascarids. While there are the usual three lips or jaws, they are of a different shape and are furnished with lobulations of the skin, but unarmed. The neck is smooth for a short distance, then the skin becomes deeply striated transversely. The tail end of the female is straight and sharp, and a short distance from the tip on the one side is the anus, and on the other a little anterior is the genital pore. The uterus is much coiled and the eggs are numerous.

Measurements

Female length	32.00 mm.
Female width60 mm.
Male length	20.00 mm.
Male width35 mm.

Echinorhynchus gaboes, sp. nov.

(Fig. 68)

The *Echinorhynchus* belongs to the family of *Acanthocephala*, a branch of Nematelminthes, or round worms, and are characterized by the possession at the head end of an armed proboscis, which they have

*These rows proved to be the walls of the intestine.

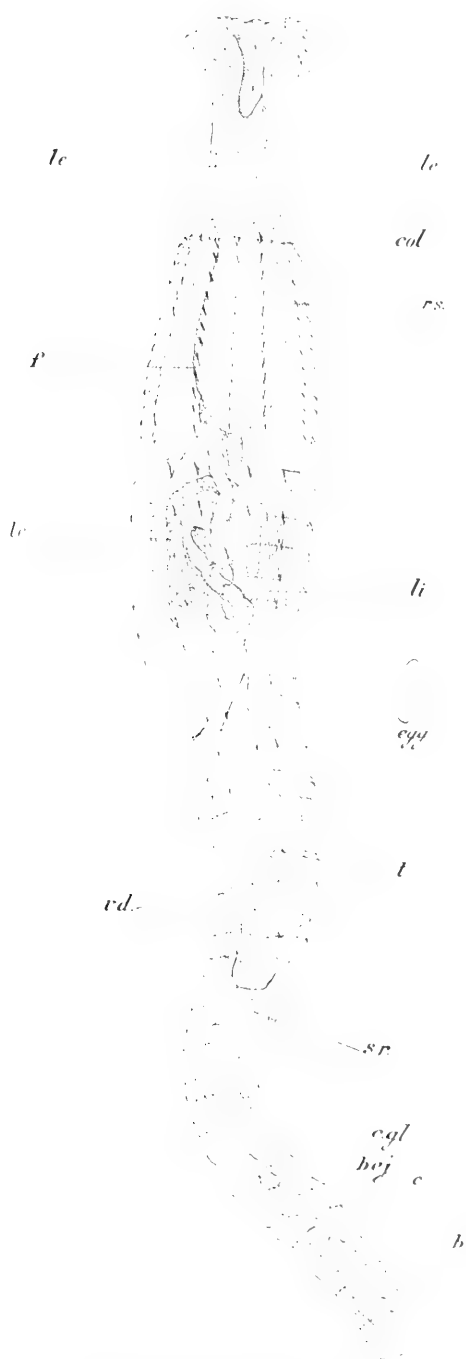


FIG. 68. *LECHINORHYNCHUS GIBBOS*

the power of protruding or retracting at will. They are not provided with a mouth or digestive system, their nourishment taking place through a process of osmosis. There is also a system of canals beneath the skin, which contain a lymph-like fluid, which is absorbed from their fluid surroundings, and there is also a pair of elongated tubes or organs near the head called the lemnisci which are credited with being the chief excretory organs. They are unusual in *E. gaboes*, since they are in a considerable coil posterior to the end of the proboscis sac. The skin is usually wrinkled and coarsely striated, and sometimes covered with strong spines, although this last feature is not common with the echino-rhynchi. There is one strong ligament running longitudinally, which seems to influence the main movements of the body. There is a very simple nervous system, which consists of a single ganglion situated at the base of the receiving sac of the proboscis, and from this nervous filaments radiate to different parts of the body.

They are of separate sexes, the male being smaller than the female. The male is provided with two testes, several cement glands, a ductus ejaculatorius, and a cirrus which protrudes into a bursal sac, situated at the posterior end of the body, which in conjugation becomes everted. These are all the organs of generation in the male mentioned by authors, but in the case of *E. gaboes* there is interposed between the testes and the cement glands a large receptaculum seminis, which communicates with the ductus ejaculatorius by means of a duct. Fig. 68. The female is provided with an ovary and there appear to be a short vagina and a uterus ordinarily. The ova are developed in the ovary, which Claus and Sedgewick say subdivides into numerous masses of eggs. These, as they become ripe, burst and escape into the body cavity, and pass from this into the uterus, from which they are forced externally. The eggs are fusiform in shape, and generally in immense numbers.

Echinorhynchs are usually parasites of fishes or birds, chiefly the former. Only one is known as a parasite of man, *E. gigas* (Goeze, 1782). The present form, *E. gaboes*, was collected by Dr. W. G. MacCallum in Borneo from the intestine of a river fish named "Ikan gaboes," and, as will be seen from the figure, is an unusually armed form. The host of this Echinorhynch was obtained at Bandjermasin Borneo, and was a large fish, black above and spotted on whitish ground below. It was thought to be a sort of Siluroid fish, although it had large scales. I am unable to describe the internal structure of the female from the fact that from the neck to the posterior end of the body cavity is filled with immense numbers of large fusiform eggs, which cover over everything and are apparently loose in the cavity. They are 10 μ long by 5 μ wide and are in different stages of segmentation. The vulva is situated about 130 μ from the posterior end. The male is 7 mm. long and the female 11 mm. and 70 μ wide. The proboscis is 45 μ long by 25 μ wide, being wider at the end than in the middle. Some of the larger hooks on the proboscis are 7 μ long and very strong.

On account of the peculiarities mentioned, I am calling this a new species. The internal structure of the male is unusual in the presence of a large seminal receptacle situated between the testes and the cement glands. The bursa is relatively large. The usual large ligament in this case is not in one single mass, extending from the base of the proboscis sheath to the bulbus ejaculatorius below, but is an open mass of filaments extending from the back of the proboscis sheath and proceeding posteriorly is spread out throughout the body as far back as the anterior testes, some of the filaments going even to the outer layer of the thick skin in some places. The skin is transversely striated into coarse divisions and is strongly armed with large spines from the head to two-thirds the length of the body. They are all pointed backwards.

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ZOOPATHOLOGICA

SCIENTIFIC CONTRIBUTIONS OF THE
NEW YORK ZOOLOGICAL SOCIETY
ON THE DISEASES OF ANIMALS



VOLUME 1, NUMBER 6

STUDIES IN HELMINTHOLOGY

Part 1—TREMATODES

Part 2—CESTODES

Part 3—NEMATODES

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ERRATA

Zoopathologica, Vol. 1, Number 5 of 1918: In notes on the Genus *Camallanus*, pg. 128, read "*Camallanus chelydrae*, sp. nov.," and at pg. 131, *Strongylus simiae* should read *Sclerostoma simiae*, sp. nov."

At pg. 92, Vol. 1, No. 3, Zoopathologica 1918: "*Spirorchis* gen. et sp. nov.," should read "*Spirorchis eustreptos* gen. et sp. nov."

At pg. 93, Vol. 1, No. 3, Zoopathologica 1918: "*Acanthodiscus mirabile* gen. et sp. nov.," should read "*Acanthodiscus mirabilis* sp. nov."

Each author is responsible for the scientific accuracy
and the proof reading of his contribution.

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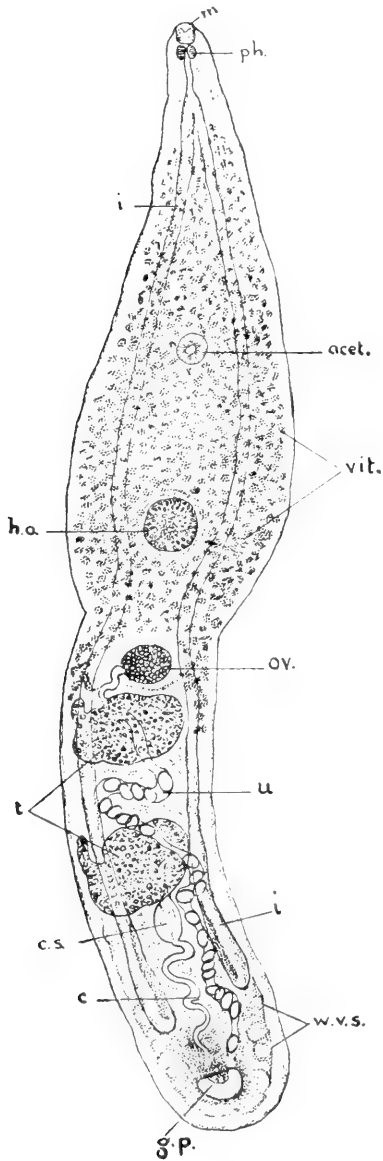
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ABBREVIATIONS

Abbreviations in explanation of plates :

a.—anus	o.s.—oral sucker
acet.—acetabulum	ov —ovary
b.c.—buccal sucker	oot.—ootype
b.—bursa	oe.—oesophagus
b.e.j.—bulbus ejaculatorius	ov.d.—oviduct
bo.—bothria	oes g.—oesophageal gland
c.b.—calcareous bodies	ph.—pharynx
c.s.—caudal sucker	p.p.—pars prostatica
c.s.—cirrus sac	pro.—proboscidae
c.p.—cirrus pouch	pr.—prostate
cl.—cloaca or genital pore	p —papillae post and preanal
ce.—coeca	r.b.—retractile bulbs
cor.—coronet	res.—reservoir
c.—cirrus	s.g.—shell gland
c.gl.—cement glands	s.—sucker
d.e.j.—ductus ejaculatorius	str.—strobila
e.—eye	s.v.—seminal vesicle or vesicula seminalis
ex.p.—excretory pore	s.r.—seminal reservoir
ex.v.—excretory vessels	sp.—spicule
g.i.c.—genito intestinal canal	t.—testis
g.p.—genital pore	tr.—tridents
h.—hook	u.—uterus
h.o.—haft organ	u.g.—unicellular glands
i.—intestine	v.d.—vas deferens
la.—larvae	va.—vagina
li.—ligament	vit.—vitellaria
le.—lemnisci	vit.d.—vitelline duct
l.c.—laurers canal	w.v.s.—water vascular system
m.—mouth	y.d.—yolk duct
m.b.—muscular bands	y.r.—yolk reservoir
m.g.—mucus glands	v.s.—ventral sucker or acetabulum
met.—metraterm	
mir.—miracidiae	

FIG. 69. *DIPLOSTOMUM BREVIS*

STUDIES IN HELMINTHOLOGY

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INTRODUCTION.

The parasites described in the following papers were found chiefly in or on animals that had died in the Zoological Park of New York City or on fishes from the New York Aquarium. However, some specimens were received from friends who sent them for identification or study, and for these I desire to thank the donors sincerely. Those described as found in the East Indies were collected by Dr. W. G. MacCallum.

Studies published under the authority of the Zoological Society of New York, which holds so high a place in the scientific world, should maintain a very high standard of accuracy and completeness, and it may be thought that in describing each of these forms a more detailed and minute account of their structure, development and life history should be given. The nature of the material has set a limit, however, to what is possible in this direction, for most of these worms are from exotic animals and frequently only one mature specimen or a larval form has been found. Their life history must remain, therefore, for others to work out as the opportunity occurs, but it has been thought proper to give descriptions and illustrations of their structure, together with a name, so that attention may be called to their existence.

TREMATODES

Diplostomum brevis, sp. nov.

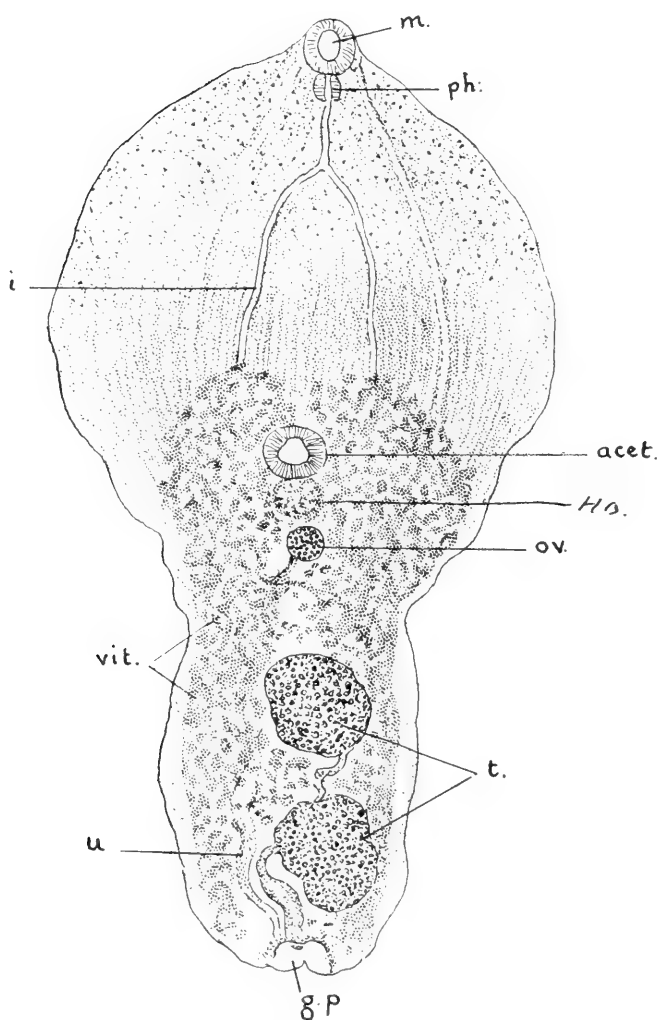
(Fig. 69)

Host—*Cinosternum scorprides*.

Habitat—Stomach and intestines.

Locality—Island of Trinidad; Zoological Park, New York.

On January 23, 1918, these worms were found in the same turtle as *Diplostomum cinosterni*. This reptile must have been very aged, for its plastron was very much decayed and crumbling, so also was the carapace very imperfect. There were a number of these *Diplostoma* found in the intestines, all about the same size, except the one

FIG. 70. *DIPLOSTOMUM MINIMUM*

large one. All were mature. They were of the same general structure as the large one, which was between 5 and 6 mm. in length, while these are 3 mm. \times 1 mm.

Measurements of D. brevis

Length	3.00	mm.
Width	1.00	mm.
Mouth10	mm.
Haft organ40	mm.
Ovary30	mm.
Testis65	mm.
Cloaca30	mm.
Egg09 \times .07	mm.

Diplostomum minimum, sp. nov.

(Fig. 70)

Host—*Ardea herodias*.

Habitat—Intestines.

Locality—Zoological Park, New York.

During the examination of a great blue heron from the Park, a lot of small forms were found in the bottom of a glass dish in the washings of the intestines. They were so small that they might easily have been overlooked. When, however, they were placed under the microscope, they were seen to be *Diplostoma*. At first they were thought to be *Holostoma*, but that view was discarded on further examination.

This little parasite is only about 1 mm. long \times .60 mm. wide. The mouth, slightly subterminal, is somewhat round and muscular. The anterior end of the worm which is rather transparent, is sprinkled with a number of spines. The pharynx is situated directly posterior to the mouth and is followed by the oesophagus. There is no prepharynx. The coeca divide a short distance from the pharynx and are lost under the profuse vitellaria which fill half the body. A small ventral sucker is seen about the middle of the body and behind it is an organ called by the Germans a "haft organ," or holding organ. The ovary is situated immediately behind this. It is not more than one-sixth the size of either testis, and although the oviduct can be made out for a short distance, the genital junction is not well shown. The testes are two, placed tandem, and behind the posterior one is seen the genital pore or cloaca. This is large and opening into it may be seen the uterus and cirrus. The water vascular system appears at the head as two large tubes, which separate and pass down each side of the worm to empty at the posterior end of the worm.

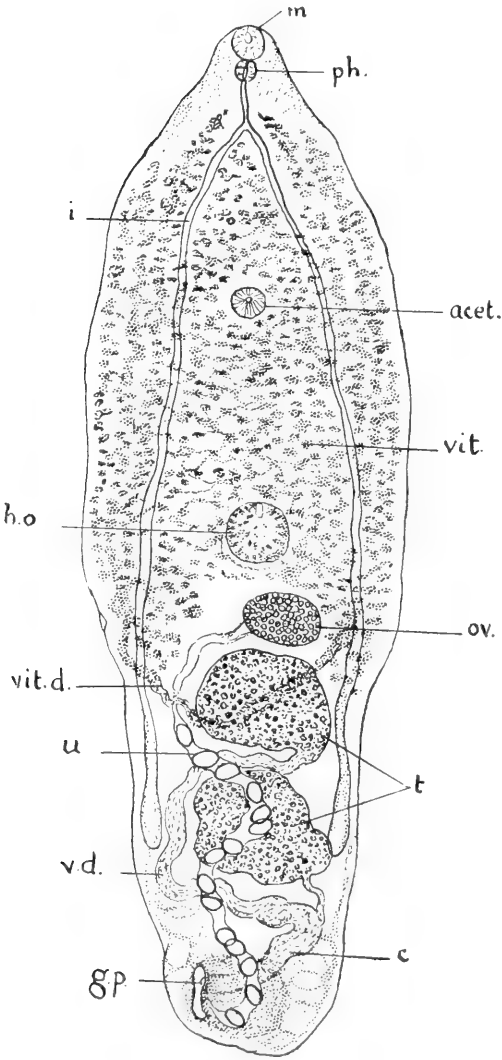


FIG. 71. *DIPLOSTOMUM CINOSTERNI*

Nordmann in 1832 was the founder of the genus with *Diplostomum volvens* as the type. A good many species have been described, but this *D. minimum*, is probably the least of them, although all are very similar in structure.

Diplostomum cinosterni, sp. nov.

(Fig. 71)

Host—*Cinosternum scorprides*.

Habitat—Intestines.

Locality—Trinidad Island; Zoological Park, New York.

A fairly large number of *Diplostoma* have been described since Nordmann first described the genus *Diplostomum volvens* as the type in 1832. One species came under my notice on January 23, 1918, in the intestine of a turtle, that had been brought from the Island of Trinidad to the Zoological Park. The host seemed to be a very aged reptile, for its plastron was much decayed and the carapace was also very friable and imperfect. I cannot find that a *Diplostomum* has hitherto been ascribed to this host and since it is different in its anatomy from any forms to which I have access, I venture to name it a new species. The head is very narrow, and the body gradually enlarges as far as its middle, when it suddenly narrows and retains the same width to the posterior end. At the head, the mouth is small, being semi-lunar in shape. The pharynx is composed of two muscular lobes, and the oesophagus is relatively long and is divided into two coeca which are narrow and extend almost to the end of the body. Just before the body narrows into the posterior half, an organ is seen which is peculiar to the *Diplostoma*—that is a holding organ, called by the Germans a "haft organ." This is a large sucker, different from the usual acetabulum. It has an opening in the centre and the rest of the surface is covered with papillae. It is as large in diameter as the ovary, and its function is to retain the worm in its place. Between this organ and the division of the coeca is a small acetabulum. In the posterior half of the body are located the genital organs. The ovary is relatively small, and is placed anterior to the two testes. These are each about twice the size of the ovary. The genital junction is in the space between the ovary and the first testis, the oviduct being given off from the posterior surface of the ovary and joined almost at once by the vitelline ducts. The shell gland is indistinct and no seminal reservoir is seen. The vasa deferentia pass backward and form a large tube, which serves as a cirrus sac. No enlarged prostate is seen as shown in *D. longa* by Braun. The cloaca is a large opening very near to the posterior end, and is in all respects the genital pore. The uterus terminates in this cloaca, as does the cirrus. Very near the edge of the cloaca is said to be an accessory acetabulum,—a sort of accessory clinging organ, but it is not to be

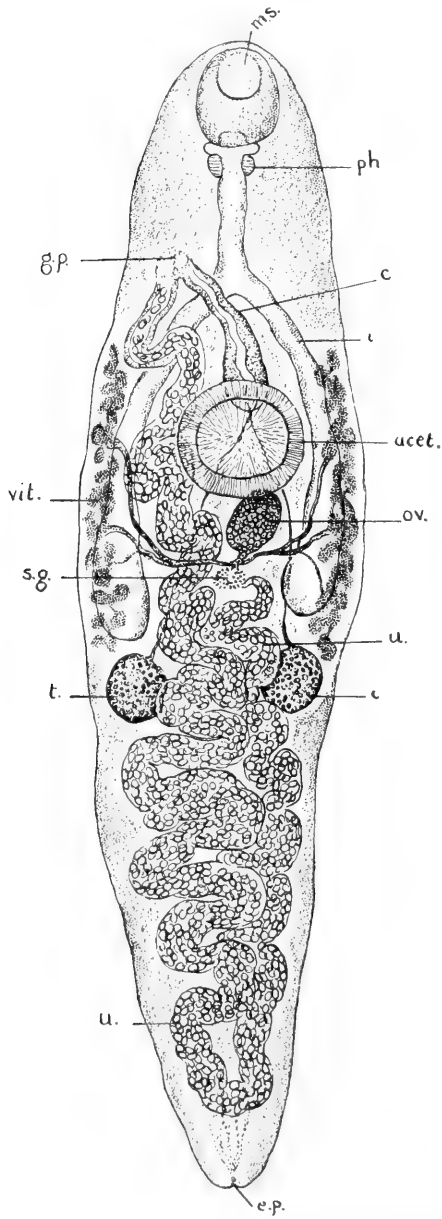


FIG. 72. *RENIFER ANCISTRODONTIS*

seen in this species. The water vascular system is quite evident terminating at the posterior edge of the genital cloaca. The vitellaria are very plentiful, and extend from the division of the coeca anteriorly to the anterior testis, posteriorly, and between the holding organ and the ovary. The space is filled all around the body with vitellaria. The uterus is small and does not contain many eggs. These latter are large, yellow and oval. These worms are never found in numbers in their hosts, so that it is not at all likely that they are very injurious.

Measurements of Diplostomum cinosterni

Length	5.00 mm.
Width	1.00 mm.
Width of posterior half of body.	.80 mm.
Across mouth20 mm.
Testes60 mm.
Ovary20 mm.
Holding organ20 mm.
Egg020 × .010 mm.

Renifer ancistrodontis, sp. nov.

(Fig. 72)

Subfamily—*Brachycoeliinae*, Lss.

Genus—*Brachycoelium*, Duj.

Host—*Ancistrodon contortrix*.

Habitat—Mouth.

Locality—Zoological Park, New York.

On July 17, 1918, there was found at the angle of the jaws in the mouth of a copperhead snake, *Ancistrodon contortrix*, a solitary distome, which is unusual not only in the choice of its habitat, but also in its anatomy.

It is elongated, body larger anteriorly than posteriorly. The mouth is subterminal and large with pharynx also large. Between the mouth and the pharynx, and at the beginning of the oesophagus is a square structure which forms a small coecum on each side, which extends laterally beyond the transverse diameter of the pharynx. The oesophagus is long and wide. It divides some distance in front of the acetabulum, and the coeca which are wide terminate in front of the testes and a short distance posterior to the acetabulum. The acetabulum is very large, occupying fully half the width of the body of the worm. The testes are two, situated some distance posterior to the ends of the intestinal coeca, and behind the middle of the worm, one on each side. The vasa deferentia are distinct and remain separate until just before entering the cirrus sac, which lies partly behind or dorsal to the acetabulum. It is large and the cirrus extends to the genital pore, which, in this case, is not situated in the angle of the

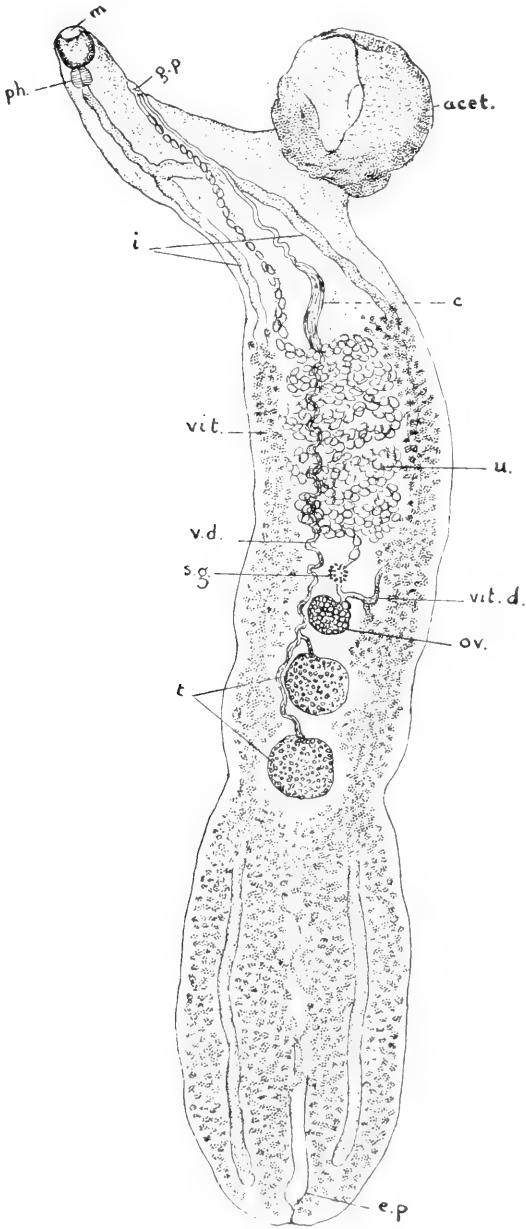


FIG. 73. ALLOCREADIUM PRIACANTHI

coeca, but anterior to the division, and to the right side. The female genitalia are very distinct. The ovary is situated at the lower edge of and partly dorsal to the acetabulum. It is roundish and about the same size as the testes. The vitellaria are foliated and limited in quantity, extending along the sides from a short distance in front of the acetabulum and terminating at the ends of the short coeca. The vitelline ducts are large and branched on their way to the oviduct. The shell-gland is distinct, but no seminal reservoir or Laurer's Canal is seen, owing to the voluminous uterus full of ova. The water vascular system is much branched and terminates at the excretory pore, posteriorly, being covered by the folds of the uterus almost throughout.

Measurements of R. ancistrodontis

Length	7.00 mm.
Width	2.00 mm.
Across mouth70 mm.
Across acetabulum	1.00 mm.
Across pharynx30 mm.
Ovary40 mm.
Testes40 mm.
Ova04 × .02 mm.
Length of oesophagus.....	.60 mm.

Allocreadium priacanthi, sp. nov.

(Fig. 73)

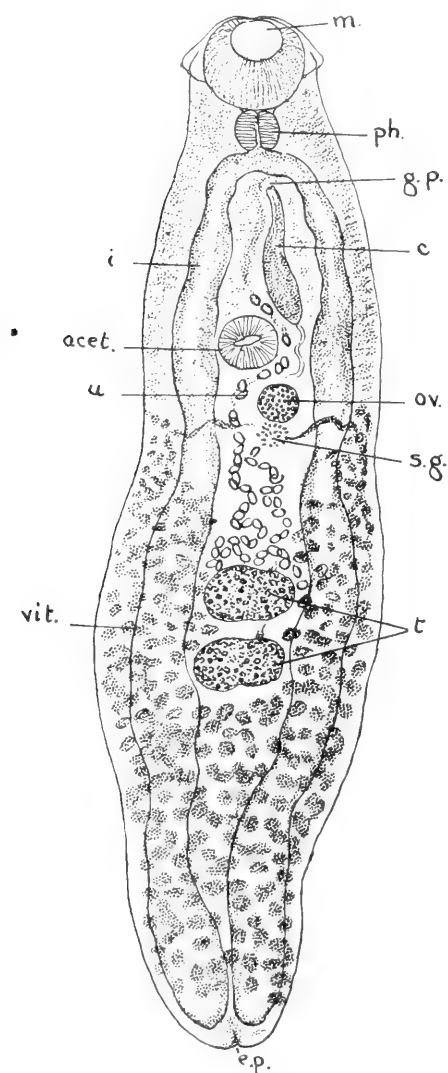
Host—*Priacanthus arenatus*.

Habitat—Intestines.

Locality—Key West; New York Aquarium.

On June 20, 1918, there were found a few worms in the intestines of a red fish, *Priacanthus arenatus*, which are very unusual and, as far as I can find, are not recorded. I therefore propose the name *Allocreadium P. priacanthi*.

In shape it is peculiar, and the mounted specimen does not do it justice. In life it varies in length from 5 mm. to 12 mm., and the portion behind the testes widens to 2 mm. and is flapped about in an odd manner. It then shows too, more plainly its division into three parts, made by the two intestines passing near the sides to the extreme end and a very prominent water vascular canal down the centre and terminating in a large excretory pore. The intervening space is profusely filled with rich, bronze colored vitellaria. The two testes are situated at the junction of the posterior with the two anterior thirds of the body with the ovary directly in front of them. The testes are roundish, as is also the ovary, but the latter organ is much smaller than the testes. The vasa deferentia arise from the anterior borders of the testes and pass dorsal to the ovary and terminate in a fairly

FIG. 74. *RHYTIDODES CHELYDRAE*

large cirrus sac which is situated on the right side and a little posterior to the acetabulum. It is much curved and ends in the cirrus which is seen at the genital pore on the left side of the neck at a point nearly opposite the posterior edge of the pharynx. The ovary is round and gives off the oviduct from its anterior edge, and it is near this point that the genital junction takes place. The vitelline ducts proceed backwards from each side to join the oviduct and the seminal reservoir is situated in front of the ovary. Its duct also joins the oviduct near the ovary. The shell gland is quite large and in one or two of the cases is towards the left side. The uterus is well filled with fairly large, yellow, oval eggs, which may be seen anteriorly in a single line making towards the genital outlet. The vitellaria are very profuse and extend more or less over the whole body from the posterior end, nearly or quite to the posterior end of the cirrus sac.

The anterior end of the worm is unusual. The mouth is a rather large subterminal space surrounded by a large thick roll or lip, but the mouth proper is a rather small circular opening near the anterior margin. The pharynx is a fairly large muscular structure. The neck, or that portion between the mouth and the acetabulum is deeply concave from side to side, and indeed much of the time the body of the worm, when alive, was also concave from side to side. The acetabulum is a beautiful filmy structure located on a quite long pedicel, which is placed at right angles to the neck. The pedicel is fully as long as the depth of the acetabulum.

Measurements of A. priacanthi.

Length	5.00 mm. to 11.00 mm.
Width	1.00 mm. to 1.50 mm.
Acetabulum7 to .8 mm.
Mouth sucker3 mm.
Mouth proper1 mm. across
Pharynx15 mm. long \times .12 mm. wide
Testes5 mm. in diameter
Ovary3 mm. in diameter
Ova05 \times .03 mm.

Rhytidodes chelydrae, Stafford, 1900

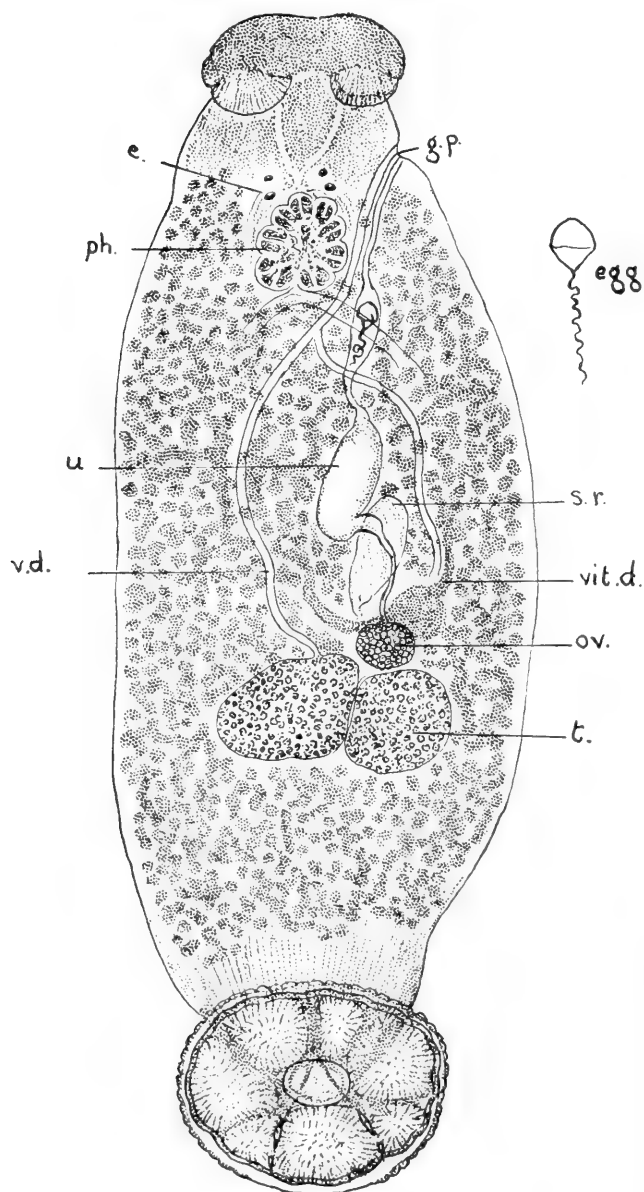
(Fig. 74)

Host—*Chelydra serpentina*.

Habitat—Intestines.

Locality—Zoological Park, New York.

Distomes are not very common in the turtles and when five good specimens were found in this host, it was thought worth while to record the find, although Stafford in 1900 recorded probably the same

FIG. 75. *ACANTHOCOTYLE SQUATINÆ*

worm under the name *Distomum chelydrae*. I have not the advantage of seeing Stafford's paper, so that I merely presume that this is the same worm. It is small, and the head is provided with lateral sac-like appendages on each side of the mouth, which is subterminal and relatively large. This is followed by a well-defined pharynx which opens at once into the coeca. These are large and extend to the posterior end of the worm, where between the two coecal terminations is the excretory pore. The intestines seem to be stuffed with small particles of apparently undigested food, looking like small bits of chitinous material or vegetable matter, thus indicating that the worm does not exist on the blood of its host, but on what is ingested by the host. Close up to the division of the coeca is the genital pore with the uterus and cirrus opening here. The cirrus is enclosed in a relatively large cirrus sac and the terminal end of the cirrus is divided into three parts. The acetabulum is not quite as large as the mouth. The ovary is small and round and gives off the oviduct from its posterior side, where the genital junction can be plainly seen. The uterus is not large and the eggs not very plentiful. They are yellow and oval. The two testes are roundish, one before the other, some distance posterior to the ovary. The vitellaria are very plentiful, extending from opposite the ovary to the posterior end, filling up the whole posterior two-thirds of the body.

Measurements of R. chelydra

Length	3.00 mm.
Width60 mm.
Testes20 mm.
Ovary10 mm.
Head across....	.40 mm.
Eggs05 mm. long and .03 mm. wide

Acanthocotyle squatinae, sp. nov.

(Fig. 75)

Host—*Squatina squatina*.

Habitat—Gills.

Locality—Singapore.

On July 16, 1916, there were found at Singapore on the gills of a monk fish, *Squatina squatina*, a lot of Trematodes, which appear to be new to science.

It is unique in appearance and presents several new features. The head is a somewhat lobulated structure appearing almost like bothria, two of which show on the ventral aspect, and probably there are two on the opposite side also. These structures are more in the

shape of flaps. There does not seem to be any armature about the head. Leading through the centre of what appears to be the neck is a wide triangular structure, the base of which is anterior, and the apex terminating in the pharynx, or in a short prepharyngeal oesophagus first. No mouth is distinctly outlined with definite lips, and it may be that the very efficient looking pharynx serves the function of mouth, etc. In front of the pharynx are four fairly large eyes. The two anterior ones are circular in shape, while the posterior pair are semilunar, although the outline of the rest of the circle can be seen outlining a transparent portion. The posterior ones are wider apart than the anterior ones. The pharynx is a remarkable looking lobulated organ, quite different from the ordinary pharynx in other trematodes. It seems to be enclosed in a loose membranous sac or sheath. From its posterior and lower part, the coeca are seen to separate and pass under the vitellaria. These cannot be followed throughout their course on account of the dense supply of vitellaria, but it is evident that they do not extend further posteriorly than the anterior margin of the testes. The testes are two large globular organs situated at about the junction of the posterior and middle thirds of the worm. The vasa deferentia pass forward widely separated in the centre of the worm, but join together a short distance posterior to the angle of division of the coeca. They terminate in the cirrus, which proceeds past the side of the pharynx to the cloaca or genital pore on the left side of the neck of the worm.

The ovary is small and globular and is situated anterior to the testes and resting upon both. The oviduct proceeds from its anterior aspect, but the genital junction cannot be seen on account of a large mass of the vitellaria, the reservoir lying directly over the region and obscuring it from view. The oviduct, however, continues its course anteriorly to join the sac-like uterus. This latter organ is intended to contain only one egg at a time. The vagina opens at the common genital pore and joins the uterus. In one specimen, an odd-shaped egg may be seen making its way to the outlet. The egg is supplied with the posterior chitinous filament, which enables it to become entangled among the filaments of the gills to be retained there until hatched.

At the beginning of the oviduct, the vitelline ducts, one from each side and through the reservoir, communicate with the oviduct, after that structure receives the duct from the seminal reservoir. This latter sac, in this instance, is relatively quite large. The vitellaria are unusually profuse, filling up almost the whole of the body. The sucker or posterior clinging organ is a very delicately formed structure. It is circular, not quite as wide as the widest part of the body, and its concave surface is divided into seven divisions or small suckers in addition to the central circular sucker. On each side of the most posterior division are two large hooks and near the posterior margin two smaller hooks. These hooks do not appear as hooks

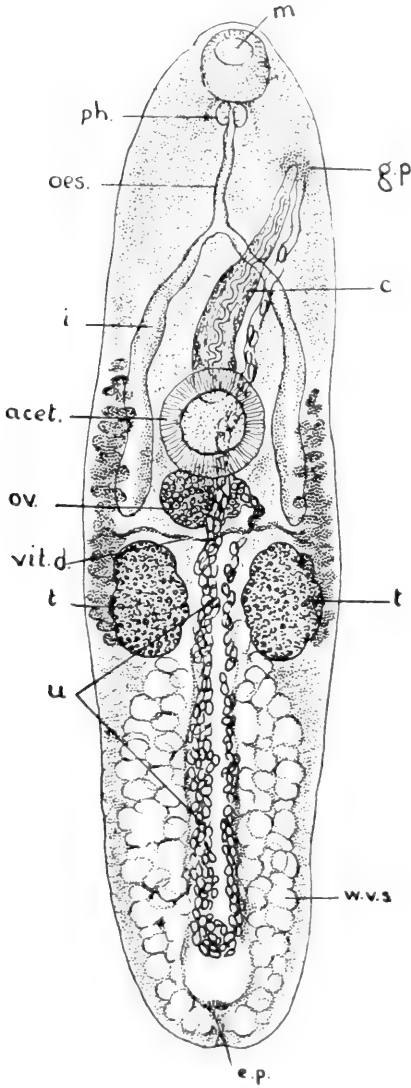


FIG. 76. *RENIFER SEPTICUS*

except the smaller ones. The large ones are more like powerful spines. In addition to these, about the margin at equal distances are very tiny hooks. The circumference of the disc has a very delicate filmy membrane, which is beautifully scalloped, but this does not extend to the most posterior portion. The pointed end of the body is attached to the dorsal centre of the sucker disc and with numerous muscular bands running up into the body, the worm has efficient control of this clinging organ.

Measurements of Acanthocotyle squatinæ

Length	4.50 mm.
Width	1.60 mm.
Diameter of disc.....	1.00 mm.
Diameter of head.....	.900 mm.
Pharynx800 mm.
Egg140 mm.
Testis	1.12 mm.
Ovary480 mm.
Length of large hooks on disc.....	.140 mm.

Renifer septicus, sp. nov.

(Fig. 76)

Subfamily—*Reniferinae*, Lss. 1899.

Genus—*Renifer*, Pratt.

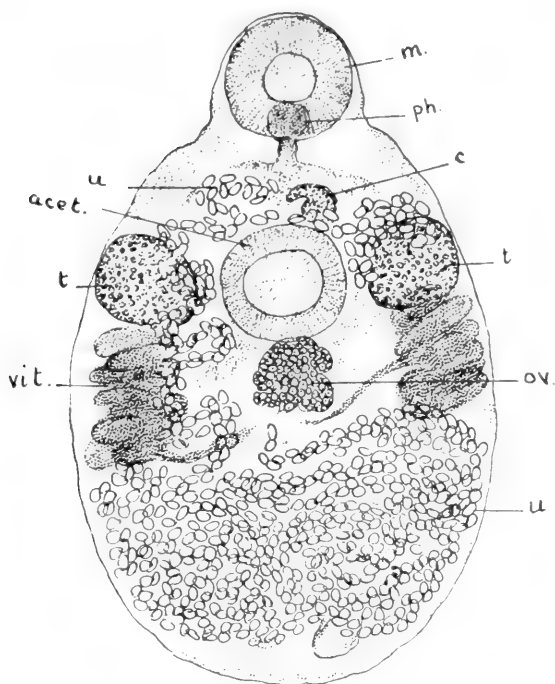
Host—*Ophibolus getulus*.

Habitat—Under the scale of the skin.

Location—Zoological Park, New York.

On November 1, 1918, my attention was drawn to certain sores on the skin of two black snakes, *Ophibolus getulus*, I had to examine, and the keeper told me that this was the cause of a good deal of trouble with some of their snakes. A lump would form and the scales would raise and loosen, and a slight discharge would stick the loosened scales together; that the condition made the reptile ill and refuse food, and he said it finally caused death. When closely examined, the swelling underneath the loosened scales was inflamed and bloody, and in each of three or four of these places I found a distome, which may or may not have caused the lesion. I give a figure of the worm which, as will be seen, is unarmed and does not look as if able to do so much harm. I shall look at such tumors as they occur in the future and see if it may be laid to the credit of the distomes.

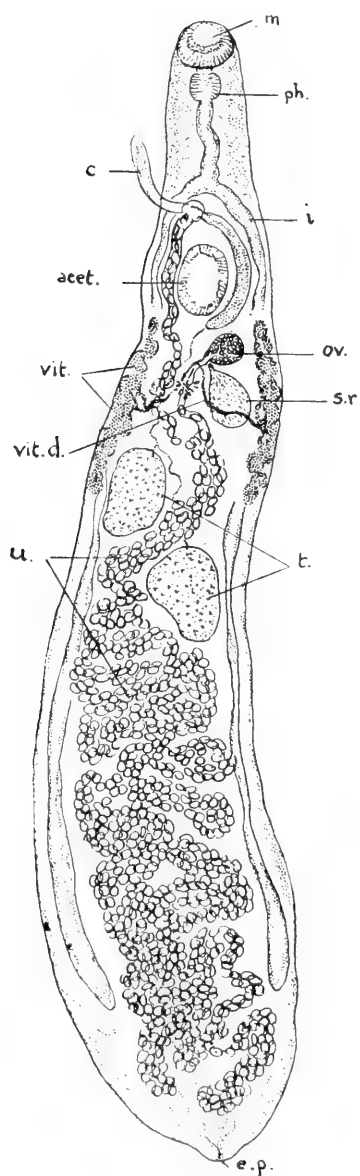
The intestines are very short and this condition constitutes the diagnosis of the genus. The uterus is of unusual shape, being merely

FIG. 77. *ZOOGONOIDES BOAE*

a double tube filled with eggs reaching almost to the posterior end of the worm and passing toward the genital pore ventral to the acetabulum and posterior to the cirrus sac and cirrus, both of which terminate at the genital pore, situated at the left side near the neck. The pharynx consists of two lobes which seem to be wider apart than usual. The testes are placed opposite each other a little posterior to the middle of the worm, and the ovary is in the middle of the body anterior to the testes and partly dorsal to the acetabulum. No shell gland is seen, neither is Laurer's Canal nor the genito-intestinal duct seen. The excretory pore is at the outlet of a sac, and indeed, the posterior half of the body on each side of the uterus is made up of small sacculated spaces which may be in communication with the water vascular system. The vitellaria extend for a short distance along each side of the middle of the body.

Measurements of R. septicus

Length	3.25 mm.
Width50 mm.
Mouth3 mm. across
Testes4 mm. long and .3 mm. wide
Ovary	2 mm. in diameter



• FIG. 78. *STYPHLODORA LACHESIDIS*

Zoogonoides boae, sp. nov.

(Fig. 77)

Host—*Boa constrictor*.

Habitat—Oesophagus.

Locality—Brazil; Zoological Park, New York.

This solitary little distome was found in the capacious gullet of a boa. It is almost circular in shape and presents the usual distoma organs. The mouth sucker is relatively large, being about the same size as the acetabulum. Oesophagus short as is the neck. The testes are large and placed one on each side of the acetabulum. The ovary is about half of their size and is placed posterior to the acetabulum. The genital pore is on the ventral surface of the coeca at their point of division. The vitellaria are immediately behind the testes and are in the shape of five or six oblong masses pointing from each side to the centre. The genital junction is posterior to the ovary and the folds of the uterus are very ample and filled with eggs which are yellow.

Measurements of Z. boae.

Length	2.00 mm.
Width	1.40 mm.
Head across10 mm.
Length of head and neck.....	.20 mm.
Eggs02 mm.

Styphlodora lachesidis

(Fig. 78)

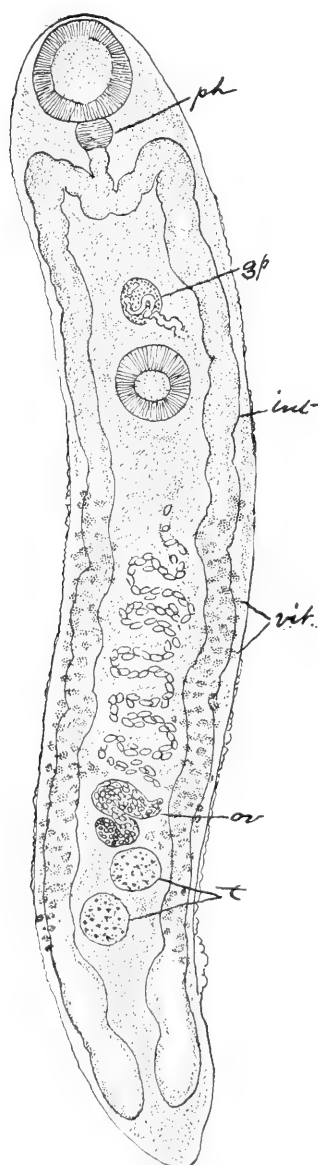
Host—*Lachesis lanceolatus*.

Habitat—Intestine.

Locality—Island of Trinidad.

On March 2, 1919, this worm was found in the intestine of a fer-de-lance, one of the most venomous snakes in the world.

The mouth is circular and subterminal. There is a short pre-pharynx and a post-pharyngeal oesophagus about five times as long. The intestines do not reach quite to the end of the worm. The genital pore is immediately in front of the acetabulum, which latter organ is about twice the size of the mouth sucker. There are two irregularly oval testes, one in advance of the other and placed on opposite sides of the worm. The vasa deferentia join and terminate anteriorly in the posterior end of a fairly large ductus ejaculatorius, which terminates in the large cirrus which is often found everted. The ovary is placed a little posterior to the acetabulum and is small. There is a small seminal reservoir. No Laurer's canal can surely be made out.

FIG. 79. *EUROSTOMUM MICROPTERI*

The vitellaria are only a few small glands situated on the sides of the worm opposite the ovary and genital junction, from these on each side the vitelline ducts may be seen joining the oviduct. There appears to be an extensive water vascular system which empties at the excretory pore. The skin is smooth throughout.

Measurements of S. lachesidis.

Length	5.00 mm.
Width	1.00 mm.
Length of cirrus.....	.360 mm.
Testes280 mm.
Ovary160 mm.
Across head240 mm.
Eggs040 \times .020 mm.

Eurostomum micropteri, sp. nov.

(Fig. 79)

Host—*Micropterus salmoides*.

Habitat—Intestine.

Locality—New York Aquarium.

This worm was a solitary specimen in the intestine of a large-mouthed black bass. It was obtained on April 6, 1915, and as it is a parasite of a game food fish, it should be recorded.

The mouth is usually large, much larger than the acetabulum, and this prominent feature has determined the name. The pharynx is relatively large and is somewhat urn-shaped—no prepharynx and a rather short post-pharyngeal oesophagus which empties into wide coeca. These latter recurve irregularly for some distance before extending to near the posterior end of the body. The genital pore is large and is situated just anterior to the acetabulum. The cirrus can be seen overlaying the pore, but no cirrus sac or even vasa deferentia can be traced. The ovary is a coiled tubular structure and is situated in front of the testes, which are one in front of the other and all three organs are situated toward the posterior end of the worm. The uterus is not very voluminous but is filled with eggs. The vitellaria extend over the middle half of the body. The skin is smooth and unarmed.

Measurements of E. micropteri

Length	4.00 mm.
Width80 mm.
Diameter of mouth.....	.480 mm.
Diameter of acetabulum.....	.280 mm.
Egg040 \times .024 mm.

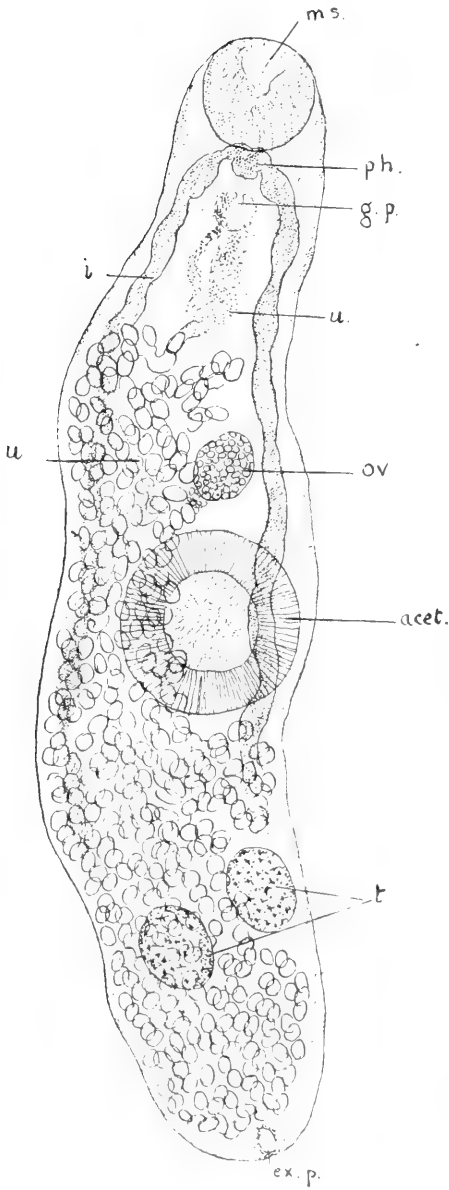


FIG. 80. *ANISOCOELIUM HIPPOGLOSSI*

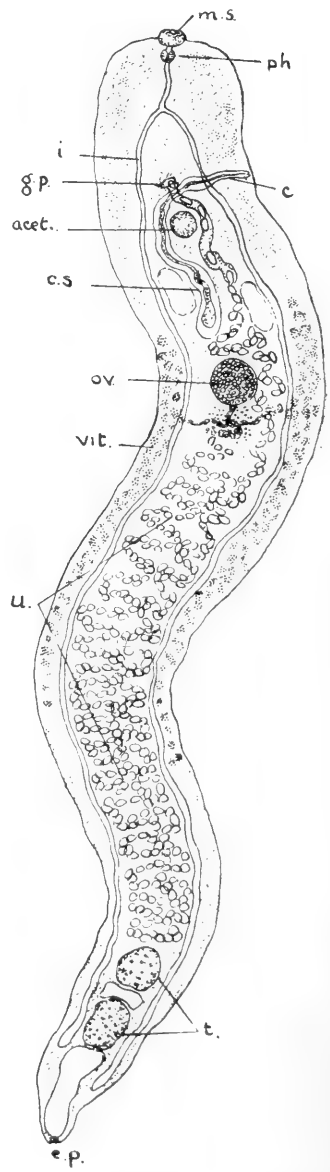


FIG. 81. *TELORCHIS ANGUSTA*

Anisocoelium hippoglossi, sp. nov.

(Fig. 80)

Host—*Hippoglossus hippoglossus*.

Habitat—Gullet.

Locality—Gloucester, Massachusetts.

These little trematodes were found in numbers in the throat of a halibut. They have no outstanding features to distinguish them from many others of this genus and yet they are sufficiently important to demand description, even if only because they are parasites of one of the most important food fishes of the sea.

The mouth is relatively large with thick irregular lips, which are generally seen to be deficient for a small space. There is no prepharyngeal oesophagus, since the pharynx opens directly into the coeca, which extend nearly to the posterior end of the worm. The genital pore is situated near the pharynx in the angle formed by the coeca. Here the uterus and cirrus make their exit. The immense number of large eggs of a rich brown color in all of the specimens at hand rather obscure the organs, yet they can be plainly traced. The ovary is situated a considerable distance in front of the acetabulum and the two testes which are a trifle larger than the ovary, are situated side by side well toward the posterior end of the worm.

The acetabulum is very large and is situated about the middle of the worm. It is twice the size of the large mouth sucker and it appears very muscular. The skin is smooth throughout.

Measurements of A. hippoglossi

Length	2.40 mm.
Width640 mm.
Diameter of mouth.....	.240 mm.
" " acetabulum360 mm.
Eggs length056 × .028 mm.

Telorchis angusta, Stafford.

(Fig. 81)

Host—*Chrysemys picta*.

Habitat—Intestines.

Locality—Zoological Park, New York.

On February 25, 1919 there were found in the intestine of a *Chrysemys picta* a number of small *Telorchis* forms. This worm, or one under the above name, was reported by Dr. Stafford from this host, but whether it is the same, one cannot say.

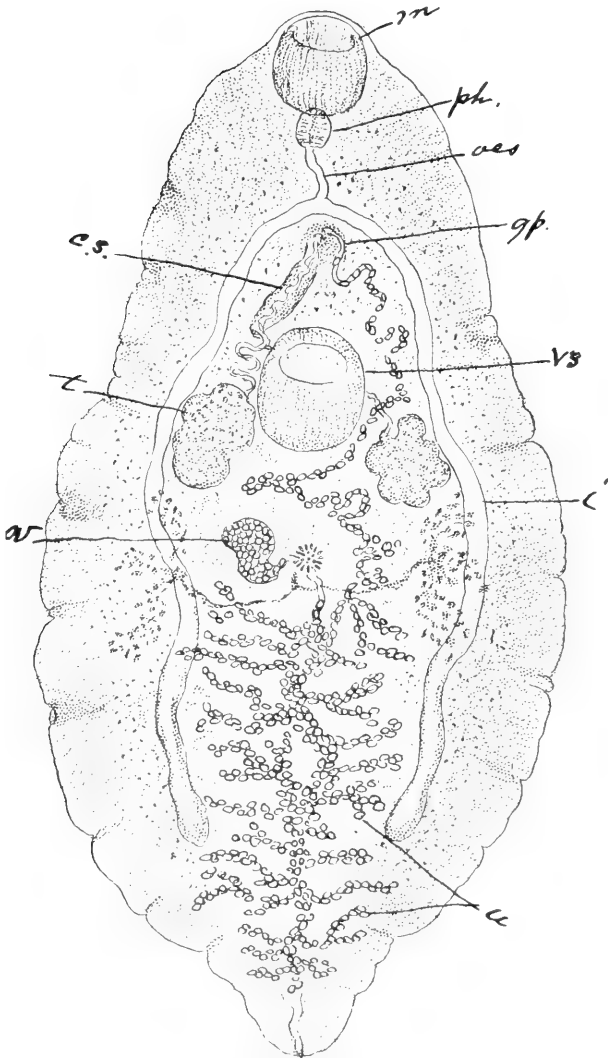


FIG. 82. *DICROCOELIUM LANCEATUM*

I have examined very closely three which I have on a slide, and the measurements are given herein. As will be seen, they differ somewhat from those of *T. angusta*, but probably not enough to prohibit their being called the same worm. The vitellaria extend from near the posterior end of the penis sac to within .800 mm. of the anterior testis. This is the chief difference between these and *T. angusta*, where the vitellaria is said to extend from the genital pore to the anterior testis. There are two water vascular reservoirs, one on each side opposite the cirrus sac, also a fairly large reservoir at the posterior end. Those were not described for *T. angusta*, but may have been present. Cirrus ventral to the coeca in these worms.

Measurements of T. angusta.

Length	4.00 mm.
Width560 mm.
Anterior sucker120 mm.
Acetabulum120 mm.
Pharynx80 mm.
Cirrus200 mm.
Ovary160 mm.
Testis200 mm.
Oesophagus160 mm.

Dicrocoelium lanceatum, Stiles & Hassall, 1896c

(Fig. 82)

Family—*Fasciolidae*, Rail. 1895.

Genus—*Dicrocoelium*, Stiles and Hassall.

Host—A buffalo.

Habitat—Intestines.

Locality—Hong Kong, China.

This member of the great family of Fasciolidae has been as usual named and renamed by many writers, often merely to suit their individual taste. Its synonymy—Petite Doure. *Fasciola lanceolata*, Rudolphi 1803; *Dicrocoelium*, Dujardin 1843; *Distomum lanceolatum*, Mehlis 1825, etc., etc.

Why it should have been called *lanceatum*, one can hardly realize for from a number of good specimens before me, they do not bear the least resemblance to a lance.

The body is oval with the poles in some cases rather pointed. The mouth too is very often subterminal and is comparatively large. The acetabulum is but a short distance posterior to the mouth, pharynx small, and but a short distance anterior to the division of the coeca; close up in the angle of this division, is the genital pore. The cirrus

sac containing a much coiled vas deferens reaches nearly to the acetabulum. The testes are more or less round and somewhat lobulated. They are anterior to the ovary and nearly on a level with the acetabulum. The ovary is small and rather club-shaped. No seminal reservoir is seen. The vitellaria are dendritic in shape, scanty, and stain a bright red, the usual color being brown. The uterus fills largely the posterior half of the body, and its coils are arranged in a dendritic form. The eggs are small, plentiful, and flattened on one side. The uterus reaches nearly to the posterior end where the outlet of the water vascular system terminates after a series of small canals which inter-communicate. The skin is studded throughout thickly with fine spines. At the edges of the body the skin is in redundant folds, overlapping as if too large to cover the body.

The description of this worm will suffice generally with that of *D. pancreatum* with a few exceptions which will be given in a short description of its anatomy. It rarely is found in man, and not often in mammals in North America, although it has occurred in several animals, as sheep, deer, etc. It is chiefly an Eastern form.

Measurements of D. lanceatum.

Length	6.50— 7 mm.
Width	3.50— 4 mm.
Mouth	1.00 mm.
Pharynx240 mm.
Acetabulum	1.20 mm.
Testes360— 4 mm.
Ovary480 mm.
Eggs040 × .024 mm.

Dicrocoelium pancreaticum, Railliet, 1890

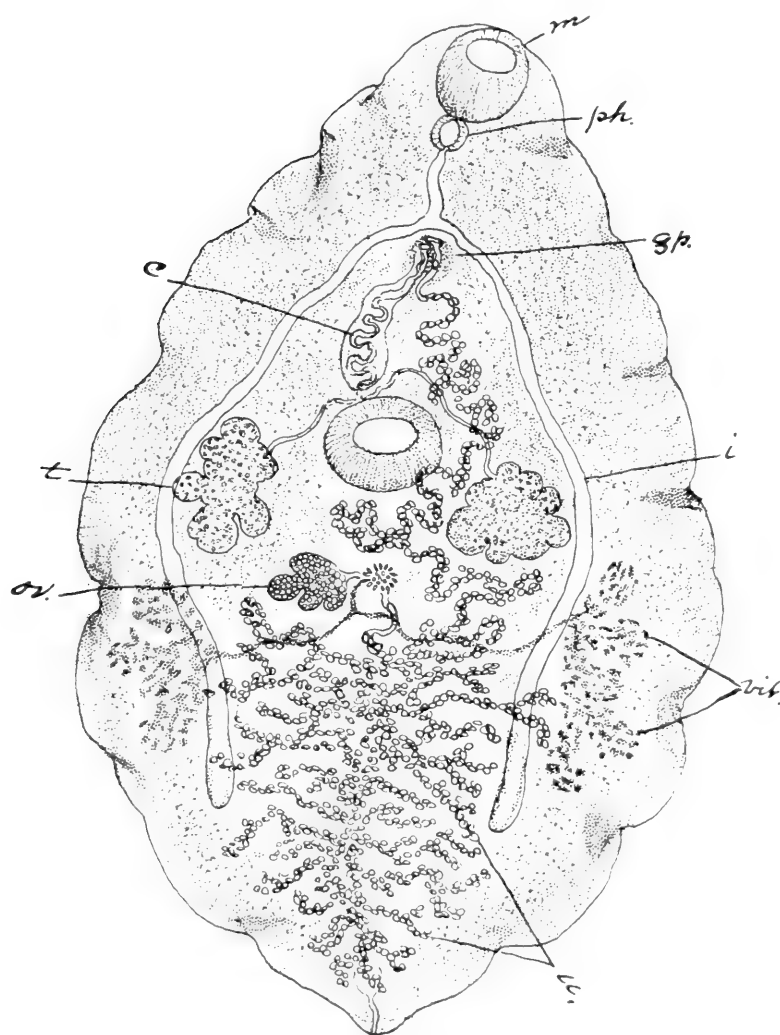
(Fig. 83)

Host—Buffalo.

Habitat—Intestine.

Locality—Veterinary School, Java.

This form differs slightly from the *D. lanceatum* in a few respects. It is of about the same size and shape, being an oval with anterior and posterior ends pointed. It is possibly more delicately formed, thinner, and more transparent than *D. lanceatum*. Testes larger and more lobulated, ovary of a different shape being distinctly lobulated, or leaf-shaped, three lobes, with the oviduct forming the stem and arising from the base. No seminal reservoir can be seen although the genital junction is usually distinct. The vitellaria are disposed dendritically and are dark brown in color, but not very plentiful. The skin, as in *D.*

FIG. 83. *DICROCOELIUM PANCREATICUM*

lanceatum, is covered with small spines and is even more redundant, the edges being much folded.

Measurements of D. pancreaticum.

Length	7.00 mm.
Width	4.80 to 5.20 mm.
Mouth circular	1.00 mm.
Pharynx200 mm.
Acetabulum	1.00 mm.
Testes	1.12 — .720 mm.
Ovary400 — .280 mm.
Uterus and eggs as in <i>D. lanceatum</i> .	

Cyclocoelum halcyonis

(Fig. 84)

Host—King-fisher, *Halcyonis coromando*.

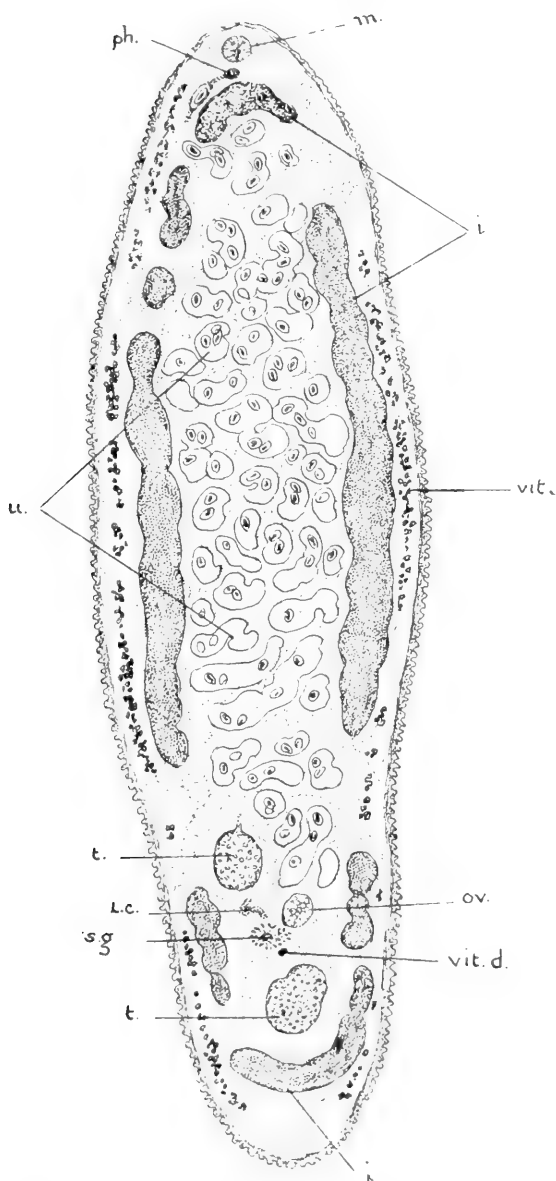
Habitat—The body cavity.

Locality—Luzon, Phillipine Island.

This worm seems to have been first described by Zeder in 1800 under the name of *Monostomum mutabile*; Creplin afterward called it *M. microstomum*. Stossich, *Cephalogonimus ovatus*, and many other authors gave it synonyms, until Brand in 1892 renamed it *Cyclocoelum*. Six or eight species have been described and Stossich seems to have been the recorder of most of them. These, he found almost all in waders, which live by the water such as *Ardea cinerea*, *Scolopax flaviceps*, *Totanus ochropus*, *Fulica atra*, etc., etc. G. A. MacCallum found it in the Congo collection as the intestinal parasite of a Guinea fowl, *Guttera plumifera schubotzi*, and called it *Cyclocoelum phasidi*, (1913). This is the first record for a gallinaceous bird.

During a trip to the Orient by Dr. W. G. MacCallum, he was given several of the above worms which had been collected from a king-fisher by Dr. MacGregor of Manila.

The worm is gray or slate colored, elongated and somewhat oval, concave ventrally and convex dorsally. The skin is transversely striated as will be seen (Fig. 84) in a section through the middle of the worm. The peculiarity of this genus is that the intestine and vitellaria are continuous around the whole body and this unusual condition serves to give the worm its name. Another peculiarity is that the genital pore is at the pharynx, consequently the eggs are discharged from near the mouth. This relates it to *Cephalogonimus*, named by Poirier in 1886. The ovary is situated near the posterior end of the body between the two testes, one in front and the other posterior. It is rather small and near it is seen a fairly large shell gland anterior to which may be seen

FIG. 84. *CYCLOCOELUM HALCYONIS*. (Section)

a section of Laurer's canal, and immediately posterior to it is seen a transverse section of the vitelline duct on its way to join the oviduct. The testes are two and each at least three times as large as the ovary. The uterus is very voluminous and full of eggs. It, with the intestines, fills the greater part of the anterior two-thirds of the body.

The vitellaria consists of a narrow line of glands which, like the intestine, surround the margin of the body, except a small portion at the anterior end. The mouth is small and subterminal. The pharynx is also small. The eggs are very large and much developed.

Measurements of C. halcyonis.

Length	12.00	mm.	
Width	3.00	mm.	
Testes720	mm.	× .560 mm.
Ovary280	mm.	× .160 mm.
Eggs120	mm.	× .80 mm.

Plagiorchis anacondae, sp. nov.

(Fig. 85)

Host—Anaconda.

Habitat—Intestine.

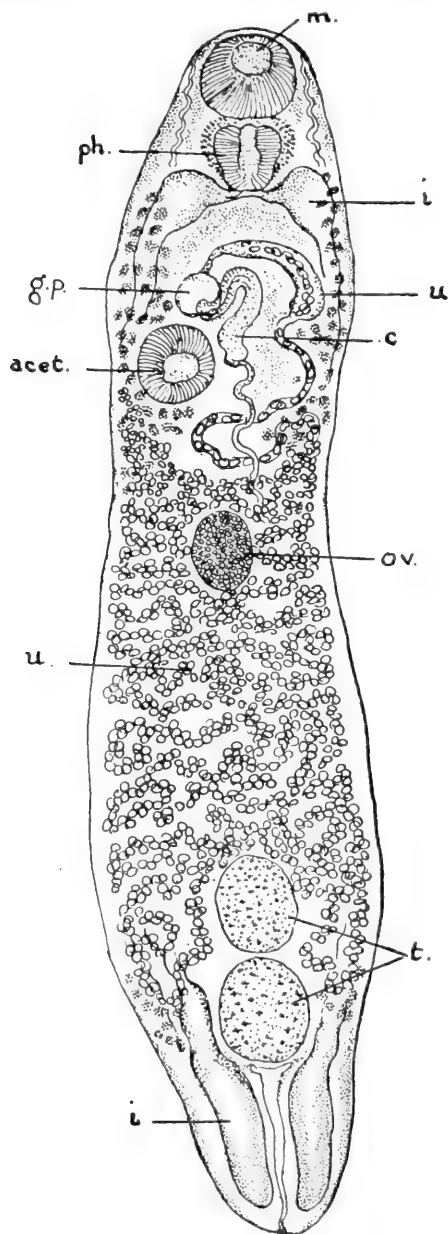
Locality—South America, Zoological Park, New York.

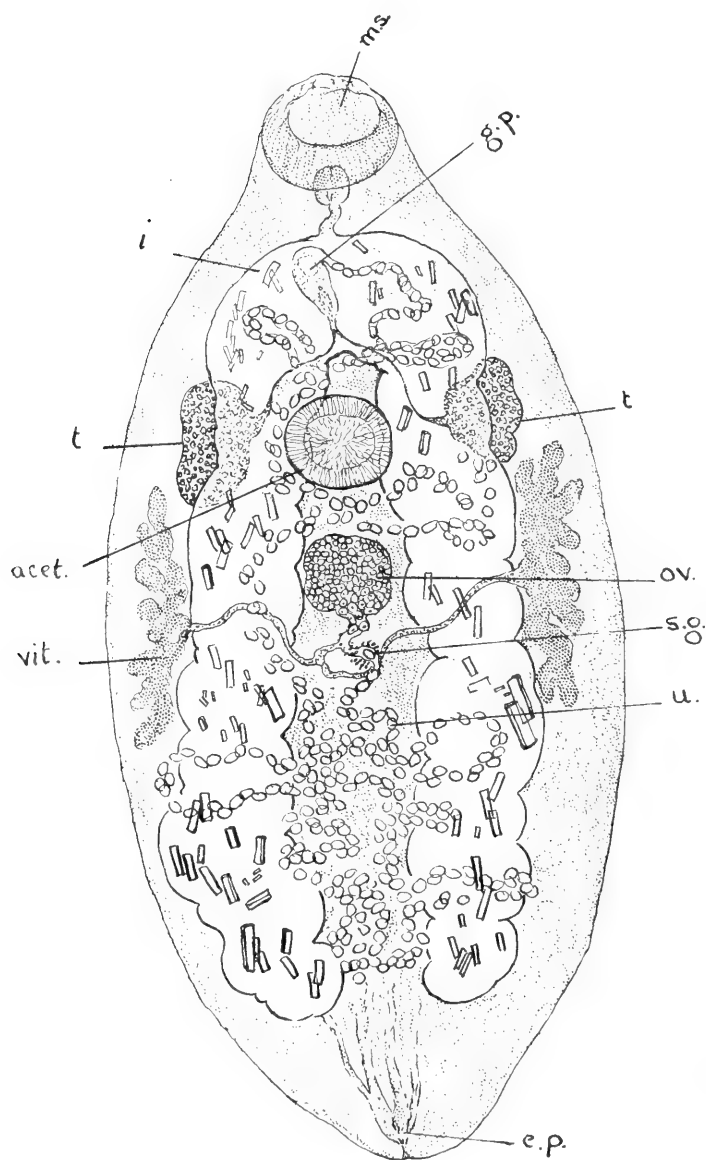
This worm was a solitary specimen in the small intestine, and when discovered was very actively stretching out its anterior end very much. This portion of the body was whiter than the rest and appeared quite triangular when at rest, the constriction being about the level of the acetabulum. The mouth is large and subterminal and is followed by a very large, somewhat triangular pharynx. This latter organ is surrounded by a quantity of unicellular glands. There is no oesophagus, the pharynx entering directly into the coeca which are much enlarged at their anterior end and recurve up on either side of the pharynx for about half of its length. They then suddenly contract to form on each side a narrow coecum which extends to the posterior end of the worm, where they terminate each in a widened sac, and there they enclose closely the two relatively large round testes.

The acetabulum is situated about one-quarter the length of the worm from the anterior end and the genital pore is just anterior to it. This pore is relatively large and it gives exit to the uterus at its anterior margin, while the cirrus protrudes from its posterior edge.

The ovary is placed in the middle of the body and is about half the size of the testes which are much posterior to it.

The water vascular system is much in evidence starting by a good sized tube on each side of the mouth and terminating in a distinct reservoir at the posterior end.

FIG. 85. *PLAGIORCHIS ANACONDAE*

FIG. 86. *PARAGONIMUS TRACHYSAURI*

The skin is smooth and thin, being unarmed throughout. Eggs are small, oval, yellow and very plentiful.

Measurements of P. anacondae.

Length	6.00 mm.
Width	1.40 mm.
Mouth across560 mm.
Pharynx across320 mm.
Pharynx length540 mm.
Acetabulum diameter560 mm.
Ovary400 mm.
Testes600 mm.
Eggs080 \times .040 mm.

Paragonimus trachysauri, sp. nov.

(Fig. 86)

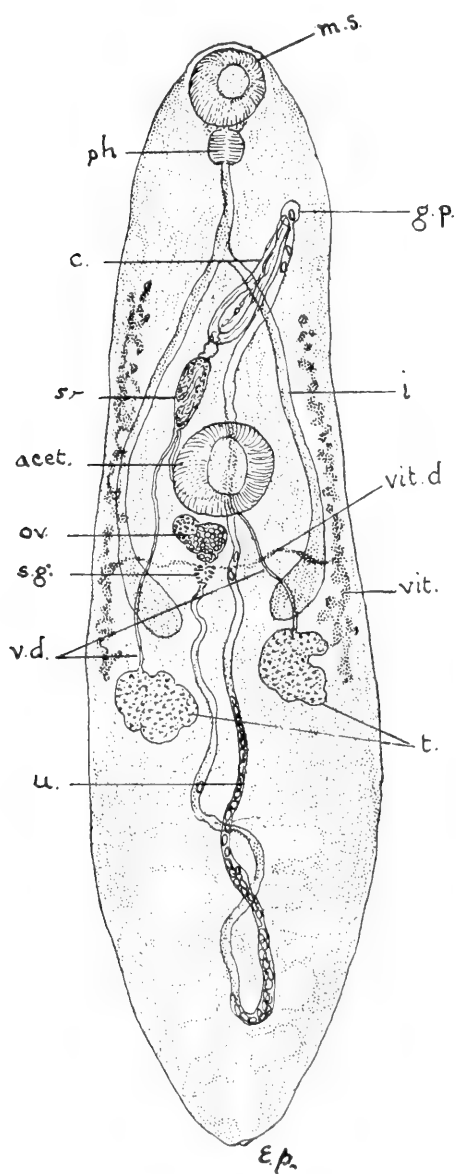
Host—*Trachysaurus rugosus*.

Habitat—Gall bladder.

Locality—Zoological Park, New York.

On August 30, 1918, there were found in the gall bladder of a stump-tailed lizard, *Trachysaurus rugosus*, from Australia about twenty distomes. These worms are quite unusual in many particulars. There were three different sizes among them, which with the decided differences in form would almost make it necessary to divide them into three species, but as they are in many particulars alike, and for brevity's sake, we shall describe them as one species. A figure of one of the largest ones is given. The mouth is large and the lips wide, and in some specimens a portion of the lip next to the neck appears to lay flat, while the narrow portion is divided from this by a line passing around the mouth, although the muscular fibrillae all run in the same direction. The margins of the lips are irregular or corrugated. The pharynx is not very large and seems to extend into the mouth for half the width of the lip. The oesophagus is about the same length as the pharynx. This terminates in the very voluminous lobulated coeca, which extend to nearly the end of the worm, and in these intestines are great numbers of four sided crystals of varying length. This is very unusual and one is at a loss to account for their presence and origin. The artist has shown these too large proportionately.

The male genitalia consists of two small testes, situated anterior to the ovary, opposite to the acetabulum and partly dorsal to the coeca. The vasa deferentia do not unite until just before their entrance into the cirrus sac, which is quite small.

FIG. 87. *RENIFER OPHIBOLI*

The female genitalia, the ovary is a roundish mass situated in the centre of the body some distance behind the acetabulum. The genital junction is formed posterior to the ovary by the oviduct being joined by the vitelline ducts and their passing through a distinct seminal reservoir. The uterus is widely coiled throughout the body ventral to the coeca, and indeed the genital pore is on the ventral surface of the wide coeca instead of being in the angle as usual. The vitellaria are not extensive and on each side opposite the ovary the masses are joined together. The acetabulum is as large as the mouth and is at the junction of the anterior and middle thirds of the length of the worm. The water vascular system is extensive and terminates at the excretory pore by the junction of several branches. The coeca are more or less filled with crystals which I am unable to name.

Measurements of P. trachysauri.

Length	5.00 mm.
Width	2.00 mm.
Testes15 mm.
Ovary2 mm.
Mouth2 mm.
Ova05 × .02 mm.
Crystals all sizes from a mere point up to .02 mm. long and .01 mm. wide.	

Renifer ophiboli, sp. nov.

(Fig. 87)

Host—*Ophiboli getulus*.

Habitat—Found in washings of intestine.

Locality—Southwest United States.

This was a solitary worm in the intestine of a king snake, but its exact habitat cannot be given.

It evidently belongs to that rather small subfamily of the genus *Renifer* which was established by Pratt in 1902, the type form being *R. ellipticus* and collected from the mouth of *Heterodon platyrhinus*. It seems to be a parasite of reptiles alone. This specimen is a delicately formed worm, as will be seen, and presents some peculiarities of form. The mouth is large and subterminal, the pharynx fairly large and the oesophagus is long, extending to the division of the coeca, which takes place at about the junction of the anterior fifth with the posterior four-fifths of the length of the body. They extend posteriorly almost exactly half the length of the worm, terminating at a point midway between the ovary and the testes. The ovary is small, about half the size of each testis and is placed very near to the posterior edge of the acetabulum. The oviduct is directed backwards, the genital junction, shell

gland which extends from near the posterior end of the worm to the genital pore, passing dorsally across the middle of the acetabulum. It contains but a limited number of eggs which are small, oval, and yellow in color.

The testes, two in number, are situated a little posterior to the middle of the worm, are irregularly nodulated, and are on opposite sides of the body. The vasa deferentia do not join until very near the end of the ductus ejaculatorius, and this contracts very much before terminating in the cirrus sac. The genital pore is situated in advance of the division of the coeca and on the left edge of side of the body. Behind the testes, the body is much given up to lacunae, connected with the water vascular system. These are all connected, and empty at the excretory pore. The skin is thin, smooth, and unarmed. It is about .080 mm. thick and composed of two layers, an outer one composed, besides the epithelium, of oblique muscular striae and an inner layer of about equal thickness composed of circular cells or corpuscles. The vitellaria are scanty, being confined to a short distance along the margins of the middle of the worm. As will be seen, it is larger than any of the other species described, being longer than *R. ellipticus*, the type specimen.

Measurements of *R. ophiboli*

Length	5.00 mm.
Width	1.40 mm.
Testes400 mm.
Ovary200 mm.
Acetabulum600 mm.
Mouth sucker440 mm.
Eggs040 × .024 mm.

Cephalogonimus trachysauri, sp. nov.

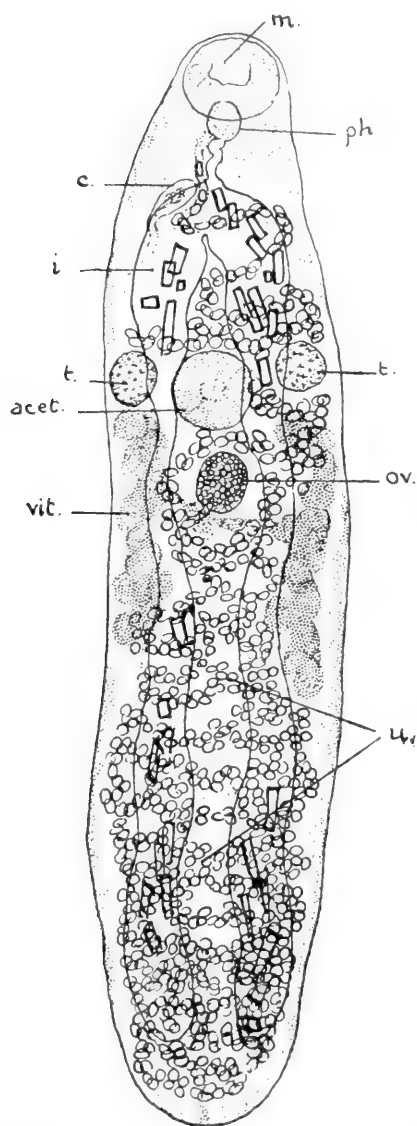
(Fig. 88)

Host—*Trachysaurus rugosus*.

Habitat—Gall bladder.

Locality—Australia; Zoological Park, New York.

While examining the above named lizard, I found in the gall bladder two different trematode worms. One I have named *Paragonimus trachysauri* and the other is evidently a *Cephalogonimus*. Poirier in 1885 discovered (*M. lenoiri*) and named it *Cephalogonimus*, ranked later as a genus, Lss. This latter organ is sometimes at the very anterior end of the worm, even extending past it, as Braun says, like a chimney. The skin is smooth and devoid of armature. I regret that the three specimens found were so filled with eggs and otherwise unfit for sectioning that some portions of its anatomy are left unshown in

FIG. 88. *CEPHALOGONIMUS TRACHYSAURI*

the plate given. However, I am sure that the identification is correct, for although the important termination of the uterus and cirrus cannot be seen, yet the uterus and vasa efferentia both disappear behind the pharynx and mouth to terminate on the dorsal surface of the anterior end.

The mouth is quite as large as the acetabulum, which latter structure is situated at the junction of the anterior third with the posterior two-thirds of the length of the body. The testes are small and placed one on each side of the acetabulum. The pharynx is followed by a fairly long crooked oesophagus which empties into the coeca. These latter organs are relatively very large and extend to near the posterior end of the worm. A peculiar point with reference to the contents of the coeca is that, as in *P. trachysauri*, there are large numbers of what seem to be four-sided crystals contained therein. I am unable to identify these. Their ends, when seen, are exactly square, but they are shown too large, relatively.

The ovary is placed posterior to the acetabulum and far behind the testes. It is a little larger than either testis, and it gives off the oviduct from the posterior side. Laurer's Canal cannot be seen partly owing to the profuse number of eggs and also to the large vitelline ducts. The vitellaria are large glandular masses on each side of the middle of the worm for a limited distance. No shell gland or ootype could be made out, nor was a seminal reservoir present which is said to be the rule.

Measurements of C. trachysauri.

Length	3.00 mm.
Width70 mm.
Ovary280 mm.
Testes200 mm.
Mouth sucker320 mm.
Acetabulum328 mm.
Eggs040 mm. $\times .020$

Holostomum variabile, Nitzsch. 1819.

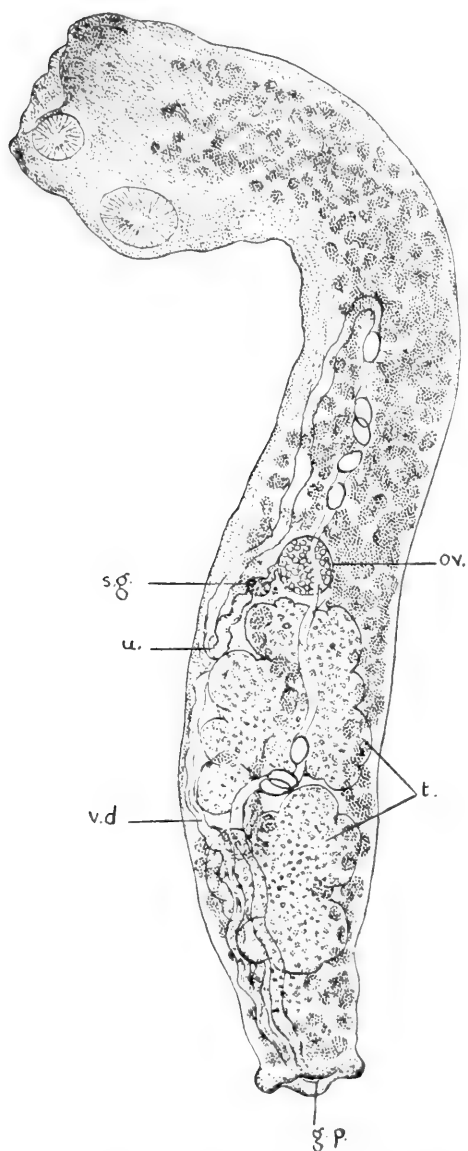
(Fig. 89)

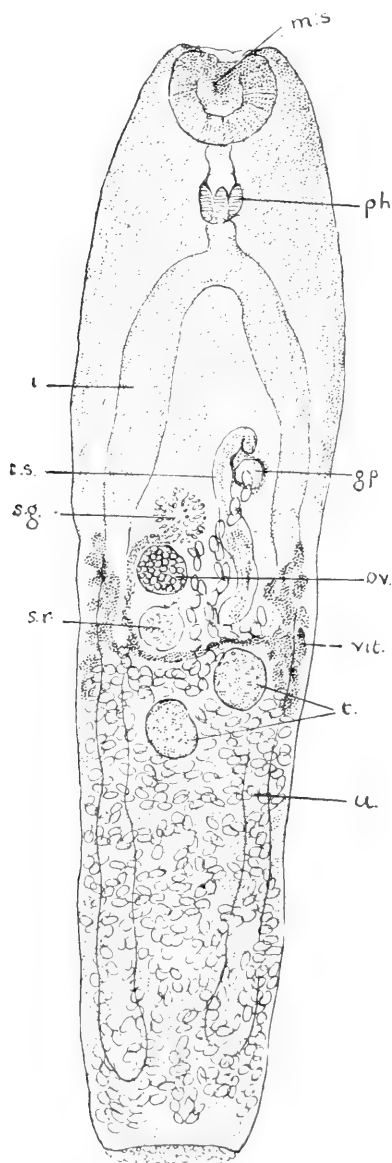
Host—*Larus atricilla*.

Habitat—Intestine.

Locality—Zoological Park, New York.

This worm, which he found in an owl and given as the type of the species, was first described by Dr. Christian Nitzsch. It is found, however, in many other birds, but apparently more often in the predatory species. As stated these were found in the intestine of a laughing gull on January 13, 1919, and I do not find it given before as a para-

FIG. 89. *HOLOSTOMUM VARIABLE*

FIG. 90. *EUSTOMOS CHELYDRAE*

site of this host, at least not in this country. *L. ridibundus*, Linn. in Europe is said to be the laughing gull of that continent, and is given as a host.

However, there were only four of these worms found in this instance. They are small and of a peculiar form, as may be seen by the plate. (Fig. 89.) The head and mouth are a funnel shaped structure with very irregular margins. On one of the lobules is a small sucker and some short distance posterior to it is another larger one. These are apparently the only holding organs the worm has. The body is generally bent, and at or near the posterior end may be seen two large lobulated testes, and almost directly in front of them, and very near them in the middle line, is seen the round ovary. This organ is comparatively small. It gives off the oviduct from the posterior lateral portion, and almost at once it passes through the shell gland and receives the vitelline ducts, then terminates in the uterus and passes forward for a coil, recurves upon itself, and extends to the posterior cloaca, where is the genital pore, contained also in an opening whose margins are much lobulated. The vas deferens also makes its way to this opening, where it probably ends in a cirrus. The eggs are few in number although relatively large. The vitellaria are very plentiful and extend almost throughout the whole length of the worm. No alimentary canal could be traced, nor could any vagina be found, unless just posterior to the large sucker, where a doubtful opening may be seen, should be given as it. This was attributed to the outlet of the water vascular system, but this is uncertain. The testes are very large, irregular in shape and fill the posterior third of the body cavity.

Measurements of H. variable

Length	4.00 mm.
Width	1.00 mm.
Sucker240 mm.
Across head	1.00 mm.
Small sucker200 mm.
Across posterior end.....	.320 mm.
Eggs120 mm. \times .064 mm.

Eustomos chelydrae, sp. nov.

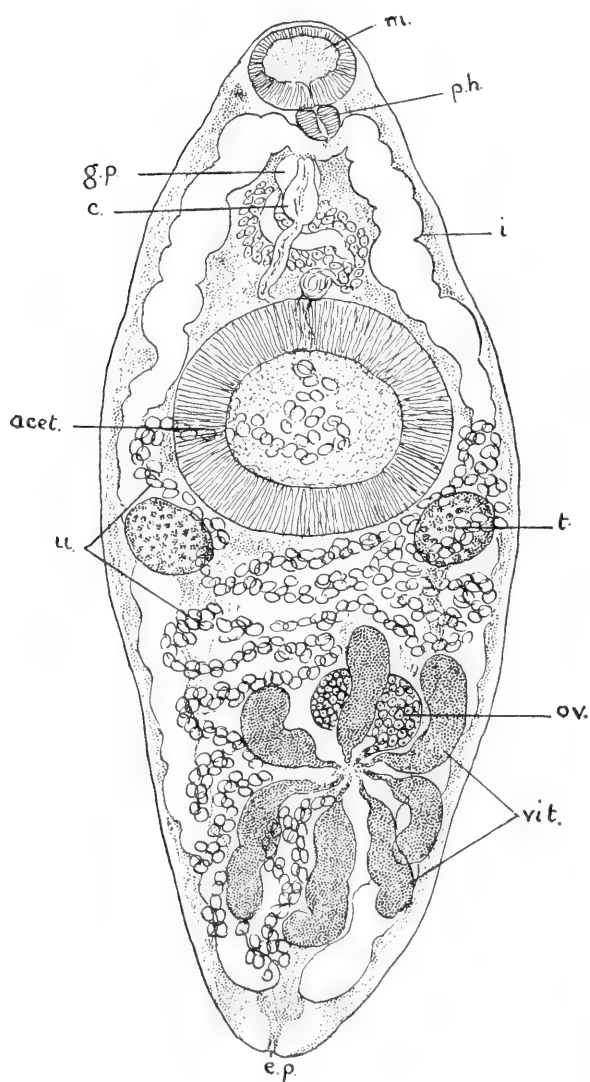
(Fig. 90)

Host—*Chelydra serpentina*.

Habitat—Intestine.

Locality—New York Aquarium.

These distomes, found in a snapping turtle, were filled with large, yellow, oval eggs, so as almost to obscure the other organs from sight. The head is almost entirely occupied with a large horseshoe

FIG. 91. *LECITHASTER ANISOTREMI*

shaped sucker, very muscular and strong and leading into a gullet or pre-pharyngeal oesophagus, and this extends into a trilobed pharynx and the post-pharyngeal oesophagus is about of an equal length with the prepharyngeal one. The coeca extend to the posterior end. There are two testes situated a little behind the middle of the worm and the ovary is in advance of these and about the middle of the length of the worm. The vitellaria are only a few glands on each side of the middle and the vitelline ducts extend completely across meeting the oviduct in front of the ovary. The shell gland is large and in front of the ovary. The seminal reservoir is relatively large and is behind the ovary. The genital pore is anterior to and to the left of the shell gland and between the coeca. The cirrus sac is long. The posterior half of the worm is filled with eggs. The posterior end is cut off squarely and curiously decorated with a fringe of small cysts.

Measurements of E. chelydrae

Length	2.00 mm.
Width50 mm.
Testes096 mm.
Ovary080 mm.
Width of mouth sucker.....	.200 mm.
Egg040 × .020 mm.

Lecithaster anisotremi, sp. nov.

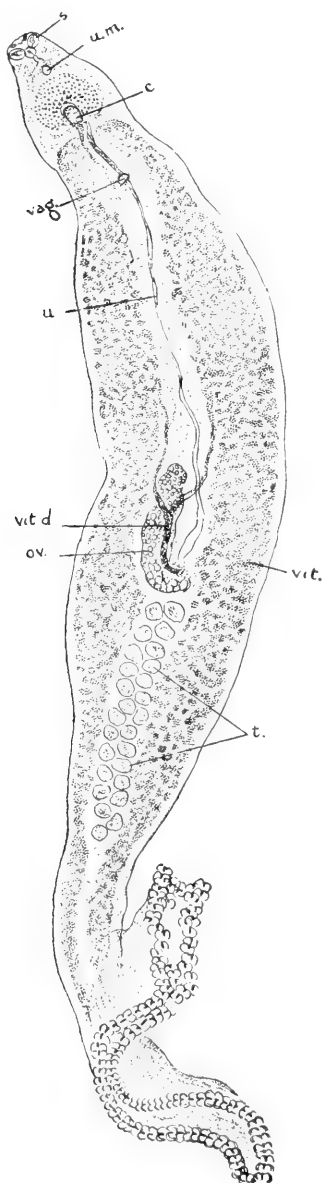
(Fig. 91)

Host—Pork Fish, *Anisotremus virginicus*.

Habitat—Intestine.

Locality—New York Aquarium, from Key West.

This small trematode, of which there were only two, was the only distome found in scores of autopsies of this host. Consequently, instead of being an injurious parasite, it is merely somewhat of a curiosity. The host does not usually harbor many parasites, especially in the alimentary tract, except *Scolices polymorphus* or an occasional *Echinorhynchus*. On the gills, however, there are almost always a number of microcotyle which may sometimes menace the life of their host. These distomes were found on May 20, 1916, and as they present some unusual features, it is thought worth while to record the find. The worm is small, very prettily shaped, and strikes the observer at once as presenting at least two very prominent organs, the acetabulum which is immensely large and the vitellaria, very odd, since they are in the shape of large dark lobules so placed as to all point by their pointed ends to one centre rosette form, and when examined closely it is found that small ducts arise from all of these points and join, evi-

FIG. 92. *MICROCOTYLE AUSTRALIENSIS*

dently the oviduct. This is very unusual. The ovary is situated near the posterior end of the worm and gives off the oviduct from its posterior side. The testes are much anterior to the ovary and placed one on each side of the worm.

The mouth sucker is relatively large, and so is the pharynx. There is no oesophagus and the pharynx opens at once into a much lobulated intestine which divides into two coeca, and these extend almost to the posterior end of the worm. The genital pore is situated in the angle at the division of the coeca, and the cirrus with a large cirrus sac, which is preceded by a fairly large ductus ejaculatorius, lies partly over the genital pore. The acetabulum is very large and muscular extending almost the whole width of the worm. The ovary is about the same size as the testes. The eggs are numerous and of good size. Their number tends to obscure the genital junction so that a more definite description of it cannot be made.

Measurements of L. anisotremi.

Length	2.40 mm.
Width80 mm.
Diameter of acetabulum640 mm.
Diameter of ovary200 mm.
Diameter of testes176 mm.
Eggs04 × .024 mm.
Ovary280 mm.
Mouth sucker280 mm.

Microcotyle australiensis, sp. nov.

(Fig. 92)

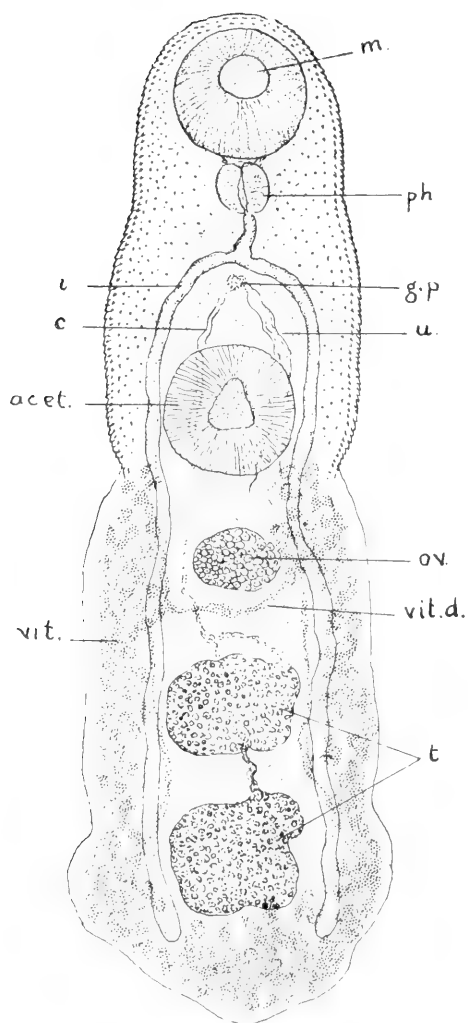
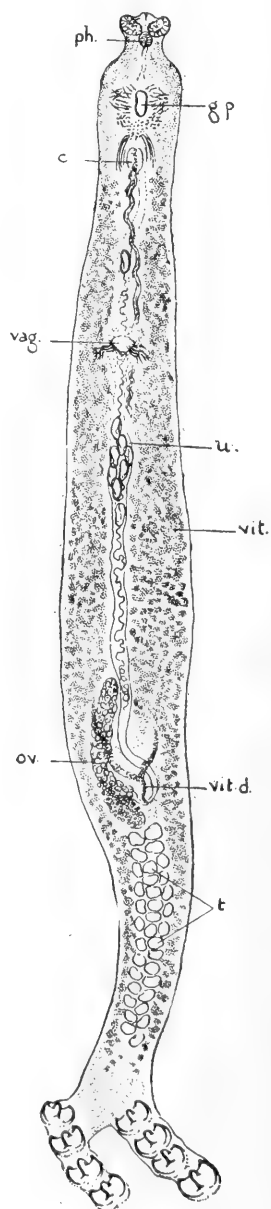
Host—*Pomatomus saltatrix*—The Tailer.

Habitat—Gills.

Locality—Sydney, Australia.

These worms were taken from a fish at Sydney, where it is called a yellow tail, and belongs to the Caranx family, quite a different fish from the *Pomatomus saltatrix* or blue fish of the Atlantic Coast.

The anatomy of this *Microcotyle* is about the same as that of the family in general. About the genital pore there is as usual a large number of hooks or spines, and the same is the case about the entrance of the vagina. The ovary is situated to the right side, and is rather small. The vitelline reservoir is in a Y-shape and joins the oviduct near the ovary. There are about twenty-five testes and the vitellaria are plentiful. The clinging organ is of a slightly different shape from ordinary.

FIG. 93. *GLOBOPORUM MORONIS*FIG. 94. *DACTYLOCOTYLE TRACHINOTI*

Measurements of M. australiensis.

Length	4.00	mm.
Width60	mm.
Across head or mouth.....	.120	mm.
Width of body at genital pore.....	.360	mm.
Length of tail or clinging organ.....	1.40	mm.

Globoporum moronis.

(Fig. 93)

Host—Sea Perch, *Morone americana*.

Habitat—Intestines.

Locality—New York market.

This little worm was found in limited numbers. It is very small, and there is nothing very peculiar about it except that the anterior part of the body, chiefly, is thickly studded with relatively long spines. If it were longer and more numerous, it would probably be very irritating to its host. One odd thing, unusual in distomes, is the fact that its vitellaria extend from its middle along both sides and across the posterior end, and is quite profuse. The intestines extend almost to the posterior end. The specimens were found January 20, 1915.

Measurements of G. moronis.

Length	4.20	mm.
Width	1.40	mm.
Across head896	mm.
Across mouth sucker....	.560	mm.
Across ventral sucker...	.560	mm.
Across ovary520	mm.
Across testes560 mm. × .640	mm.

Dactylocotyle trachinoti, sp. nov.

(Fig. 94)

Subfamily *Octocotylinæ*, V. Beneden et Hesse, 1863.Genus *Dactylocotyle*.Host—*Trachinotus carolinensis*.

Habitat—Gills.

Locality—New York Aquarium.

On February 27, 1917 there were found on the gills of a pompano a number of the above worms and in fact they have been observed on the gills of this fish often. They have not been recorded by anyone

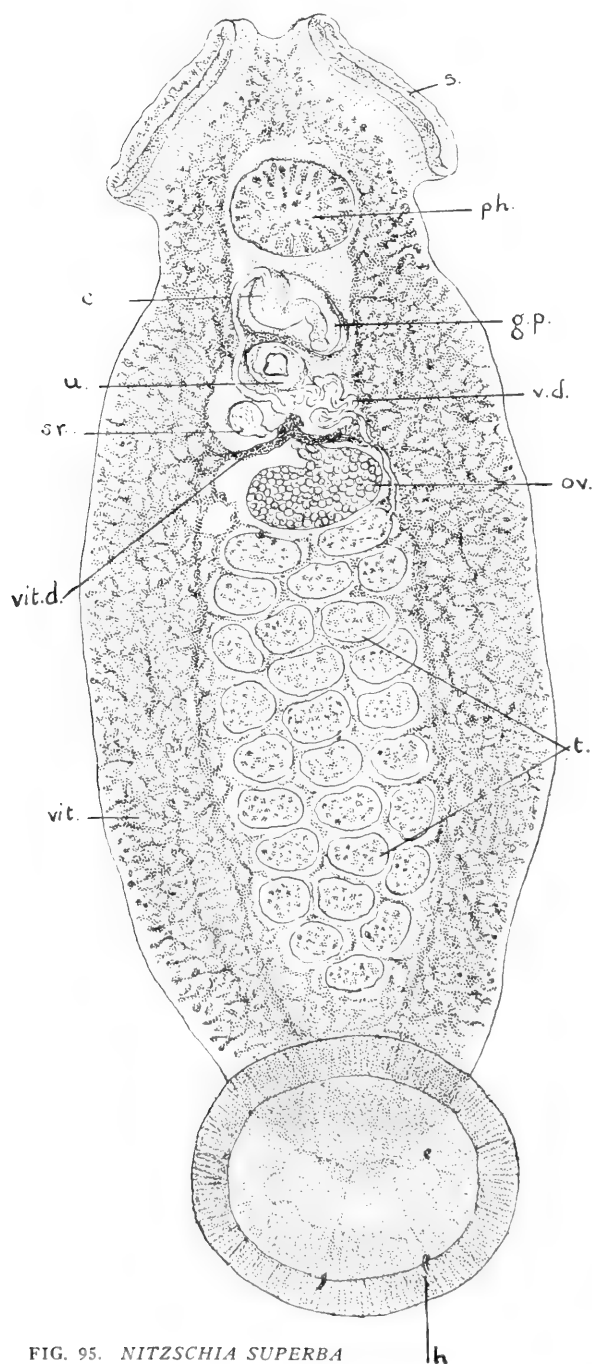


FIG. 95. NITZSCHIA SUPERBA

else, I, therefore, think it proper to report the find. Also they have been often seen on *Roccus lineatus*, but whether it is exactly the same species I cannot say at the present moment.

This species is small and very delicately formed, and the ornamentations about the genital openings are very unique. The head is somewhat expanded by the presence of a sort of compound sucker on each side of the mouth proper, which appears at the extreme anterior portion, and the pharynx is immediately behind the two suckers. The oesophagus follows and the genital pore is central and is surrounded by a lot of delicately formed hooks and spicules, and posterior to this a short distance may be seen the cirrus which is also ornamented and surrounded by both hooks and spicules. At about the junction of the anterior fourth with the posterior three-fourths is the vagina, also the site of a number of spines and hooks about it. The ovary, situated at the junction of the posterior and middle thirds, of the body, is a rather long mass giving off to the left the usual oviduct, which is almost at once joined by the duct from the vitelline reservoir, and then proceeds anteriorly as the uterus. No seminal reservoir is seen. A number of eggs are generally seen engaged in the uterus. They are fairly large, oval and yellow, and with a long filament attached to the posterior end. There are twenty-five or thirty roundish testes near the posterior end. The vitellaria are very abundant throughout the body. The posterior clinging structure, and that which gives the worm its name from *Dactylos* finger or toe, is a double process sustaining on each half four claspers at the posterior end. The general shape of the body is elongated and graceful with distinct shoulders separated from the head by a short neck.

Measurements of D. trachynoti.

Length	4.00 mm.
Width52 mm.
Length of each finger-like processes....	.48 mm.
Width of head.....	.24 mm.
Across body at genital pore.....	.36 mm.

Nitzschia superba, sp. nov.

(Fig. 95)

Host—*Acipenser brevirostrum*.

Habitat—Gills.

Locality—The Aquarium, New York, from Atlantic Coast.

On September 22, 1915, two short nosed sturgeons, a male and a female, were examined and no entozoa were found in their blackened internal organs, but on the gills were found three *Nitzschias*, which proved to be very interesting.

These worms while in general outline are much the same as Nitzschias generally are, yet the anatomy presented many points of difference. Beginning at the anterior end, the two long side suckers are most peculiar. They stand quite out from the head, two deep grooves and must be very powerful. The principal thing, however, which strikes the observer, is the immense quantity of vitellaria which covers the body almost throughout. It is also very different from that of other members of this genus, inasmuch as instead of being a mass of more or less circular glands, they are here in the form of tubes with only at short distances a circular gland here and there. These tubes cover the body from the anterior notch to the anterior margin of the posterior sucker, covering all of the internal organs more or less completely. They are a series or network of tubules, which intercommunicate and finally empty into two large ducts or tubes, which extend on each side nearly the whole length of the body. The pharynx which also serves the purpose of a mouth is large and is situated between the posterior ends of the large anterior suckers. Immediately behind this is a large genital pore, in or over which lays the cirrus with its sac. The vas deferens, a large and much coiled structure, is plainly seen entering the base of the cirrus sac. Behind the genital opening and in contact with it may be seen the uterus containing a large yellow, somewhat triangular egg. The ovary is uniform in shape and gives off the oviduct from the anterior side, and this is at once joined by the duct from the seminal reservoir and also by two large vitelline ducts, one from each side. A shell gland cannot be seen, nor a Laurer's Canal. There are from twenty-seven to thirty testes, which are large and somewhat rounded. The posterior sucker is large, very muscular and presents four small yellow hooks near its posterior margin. They are in pairs and each pair is attached to the center of the disc or posterior tip of the body by a muscular strand. The skin throughout is smooth and the bodies are not so large as *N. elegans* or *A. sturio*. Many strong muscular fibres can be seen extending from the disc up into the body.

Measurements of N. superba.

Length	7.00 mm. to 11.00 mm.
Width	2.20 mm. to 3.40 mm.
Across the head.	2.20 mm. to 3.20 mm.
Across pharynx.	1.00 mm.
Across ovary ..	1.00 mm.
Across disc	2.00 mm. to 2.20 mm.
Egg triangular..	.120 mm. long \times .144 mm. wide at base
Length of each anterior sucker—	2 mm.

Heronimus geomydae, sp. nov.

(Fig. 96)

Genus—*Heronimus*, Mac C. Oct., 1902.Host—A turtle, *Geomyda punctularia*.

Habitat—The lung.

Locality—Trinidad Island.

On February 25, 1919, a turtle was sent to me from the New York Zoological Park labelled *Aromochelys*, sp. n. with the statement that it came from the Island of Trinidad. Apparently, at the Park the officials were in doubt as to the particular species of this turtle, and I am also in doubt, owing to the meagre data accompanying it, altho it was labelled *Aromochelys*. I am told, however, by good authority that there are two species existing in Trinidad Island to which this reptile might belong, and as *Geomyda punctularia*, Daudin is apparently the more common, it probably was a specimen of that form.

In the autopsy there were found three worms in the lungs which were monostoma and tentatively I have named them as above. They are quite large and of somewhat peculiar formation. The mouth is terminal and the pharynx which is large, extends quite into the mouth cavity anteriorly and into the coeca with its posterior end. The coeca are wide at their origin, but almost at once become suddenly very narrow for a short distance, when they become wide and extend to nearly the posterior end. The genital apparatus is situated quite close to the anterior end of the worm, and is composed of two seminal sacs, one of which is the seminal reservoir, no testes seen, the ovary oval in shape and situated anterior to the seminal vessels and just in front of the shell gland and situated anterior to them. The oviduct is longer than usual and extends backward to terminate in the uterus. The vasa deferentia extend backward and terminate in an unusually large coiling seminal reservoir, which extends forward to end in the cirrus, which also coils and is situated a little in advance of the genital pore in or near the right side of the mouth. Hence it is a cephalogonimus. The uterus is very extensive and is filled with eggs and partially developed eggs, for in the terminating coils of the uterus are seen large numbers of miracidia, showing eye spots and clumps of rediae posteriorly. In this part of the uterus there is much pigment matter. The vitellaria are in two columns, lying internal to the coeca and sending two ducts across to the oviduct near its origin.

The worm is thick, and the uterus crowded with eggs from almost one end to the other.

Measurements of H. geomydae.

Length	16.00	mm.
Width	3.00	mm.
Ovary700	mm.



FIG. 96. *HERONIMUS GEOMYDAE*

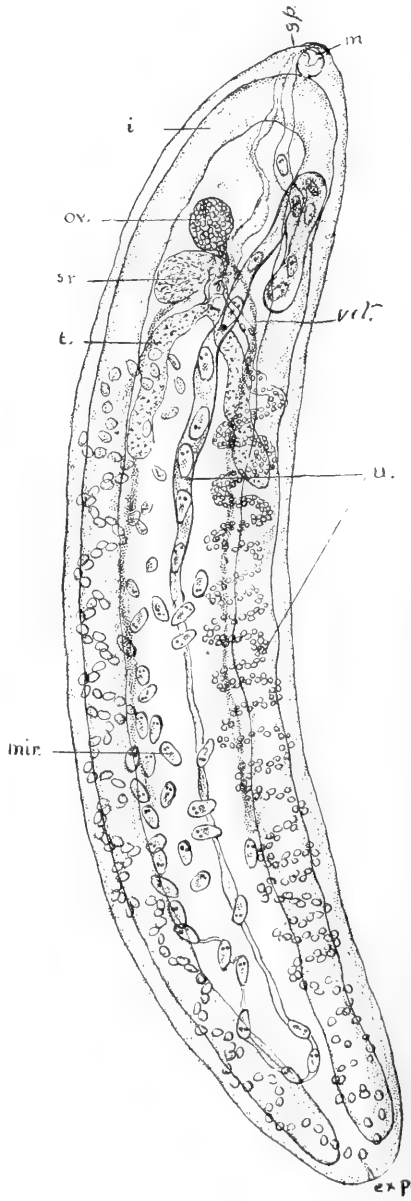


FIG. 97. *HERONIMUS MATERNUM*

Testes800 mm.
Eggs07 mm.
Miracidia012 mm.

Heronimus maternum, sp. nov.

(Fig. 97)

Host—Blanding's tortoise, *Emys blandingi*.

Habitat—Lung.

Locality—Wood's Hole, from Ohio.

During the examination of about seventeen Blanding's tortoises from Ohio, I found in the lungs two of the above parasites. The worm is about 12 mm. long and 2 mm. wide, and is generally seen in a semilunar shape. The mouth is ventral and oval in outline with a triangular opening. Immediately behind the mouth is the arch of the coeca into which the mouth opens directly without the intervention of a pharynx or oesophagus. The intestine extends along each side to near the posterior end. It is wide and filled generally with a yellowish matter. The ovary is round and situated toward the right side of the body and but a short distance posterior to the mouth. The oviduct is given off from the posterior side and coils almost at once anteriorly for some distance before it widens into the uterus. This latter, after coiling toward the head end, proceeds backward. No ootype or shell gland can be made out in the meagre material at hand. The coils of the uterus along the left side of the worm to the posterior end contain mainly eggs and slightly developed eggs or larvae. On the right side, however, the development seems greater and the miracidia begin to appear until they reach the final parts of the uterus. The walls of the uterus appear to be very thin, so much so that they are hardly visible through much of its length. In the metraterm may be seen chiefly miracidia entirely formed and with redia within. This part of the uterus, as has been said, is much pigmented. The genital pore is on the right side of the neck or mouth and very near the anterior or head end, hence the worm belongs to the genus *Cephalogonimus*.

There are two testes somewhat pyriform in shape, small end anterior. They are situated directly behind the ovary, the vasa deferentia being given off at the anterior ends and very near the oviduct at its origin. The vasa deferentia are seen in coils in the angle of the coeca. The excretory system ends at the posterior end.

It is a viviparous trematode and more than that the larvae are in the miracidium stage within the uterus. Here the miracidia show within them the masses of redia and also nucleated cells. The miracidia are .200 mm. in length and .096 mm. in width, and in some cases they are quite prolonged into a tailcovered with cilia. They vary in shape somewhat, but are generally pyriform. Each has two eyes, or

pigment spots, at or near the anterior, wider, or head end and behind these the redia may be seen. The difference in shape is probably owing to different degrees of contraction. There is a good deal of pigment in the walls of the uterus where the miracidia are, but not so much elsewhere. The eye spots are about 0.016 mm. in diameter and they are not always round. The eggs are roundish and .032 mm. in diameter. The vitellaria are not very evident and are scattered along the edge of the body throughout much of its length. The skin is unarmed and smooth.

Measurements of H. maternum.

Length	12.00 mm.
Width	2.00 mm.
Testes560 mm.
Ovary400 mm.
Mouth40 × .20 mm.
Eggs032 mm.
Eye spots016 mm.
Miracidia200 mm. × .096 mm.

Cotylogaster chaetodipteri, sp. nov.

(Fig. 98)

Family—*Aspidobothridae*.

Genus—*Cotylogaster*.

Host—*Chaetodipterus faber*.

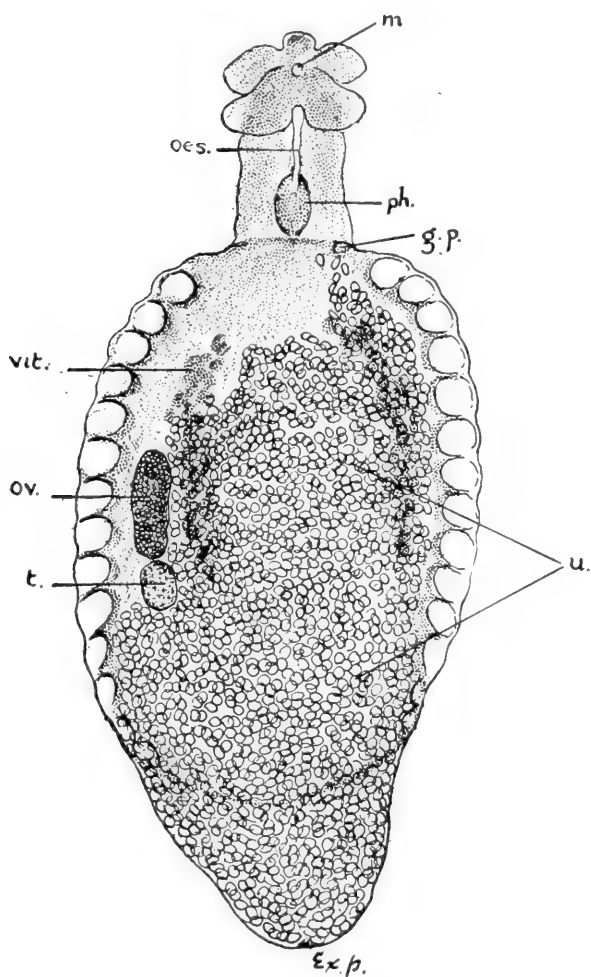
Habitat—Intestine.

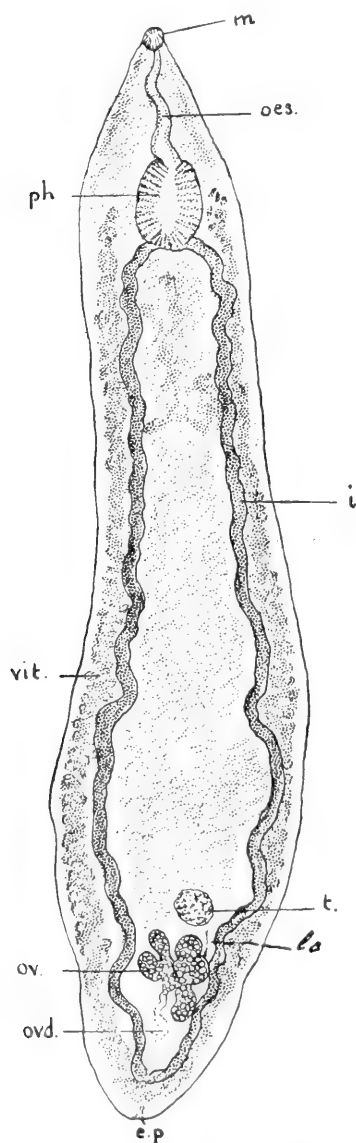
Locality—New York Aquarium.

Three of these parasites were found in the intestine of a spade or angelfish, *Chaetodipterus faber* on May 8, 1919. The host being among a consignment of fish from Florida.

The worms are not large and do not seem to be of the same species as *Cotylogaster michaeli* found in the intestine of a fish at Trieste by Mont, in 1892, which shows various differences, for instance it has a row of sucking discs around the whole margin of the body and long transverse median depressions across the ventral surface. It also has small round suckers around the whole inner edge of the body. Length 4.00 mm. to 5.00 mm. vitellaria separated masses. The head is square with a round mouth in the center. It has one testis and this is given as the type species.

Nickerson describes one in 1899 found in *Aplodinotus grunniens* and which he named *C. occidentalis*. This does not seem to be of the same species either. First it is large, 8 mm. long with 144 depressions on the sucking disk and at the dorsal end of conical elevation. The mouth seems to be the same with five large flowing lips.

FIG. 98. *COTYLOGASTER CHAETODIPTERI*

FIG. 99. *SPIRORCHIS EMYDIS*

C. chaetodipteri is much smaller than the foregoing and different in its anatomy. The head is provided with five large flowing lips about the mouth. The neck is smooth and well formed and about its middle it shows a pharynx which is large and presents a slit down its center. The body is somewhat pyriform, the base being anterior where the neck joins it in its middle. The posterior end is quite pointed. Along the margin of each side of the body there may be counted sixteen rather large sucking disks. They extend from the root of the neck to nearly the end of the body. There are no transverse depressions to be seen on the ventral surface as in *C. michaeli*.

There is only one large globular testis which is situated quite near the ovary at the right side of the body. The ovary is pyriform in shape, large and quite long. On the inner side of the ovary the vitellaria appear in the shape of long lobulated masses and these extend from near the root of the neck for two thirds the length of the body. The abdomen is so literally filled with eggs that the ducts from any of the above organs cannot be seen. The oviduct however can be seen expelling eggs through the genital pore at the junction of the neck with the body on the left side.

Measurements of C. chaetodipteri.

Length	2.50-3.00 mm.
Width	1.50-2.00 mm.
Across mouth or lips.....	.80 mm.
Across neck50 mm.
Length of head and neck90 mm.
Width of sucker on side.....	.15 mm.
Across shoulders	2.00 mm.
Length of ovary65 mm.
Diameter of testis30 mm.
Eggs010 mm. \times .05 mm.

Spirorchis emydis, gen. et sp. nov.,

(Fig. 99)

Family—*Spirorchidae*.

Sub-family—*Spirorchinae*.

Host—*Emys blandingii*, Blanding's turtle.

Habitat—Lung.

Locality—Ohio, U. S. A. .

In a paper on *Telorchis* and other trematodes (Zoopathologica) (New York Zool. Soc., 1918, I, 81) I described a worm from the intestine of *Chelopus insculptus*, giving in the generic name *Spirorchis*. The same worm had been found by me previously (in 1912) in the

lung of *Chrysemys picta*. Unfortunately, through an error the specific name *eustreptos*, which was intended, was omitted. Ward in his paper of March 1921 (Journal of Parasitology), without consulting me, and without studying the form, suggests the specific name *innominata*. But this name is not acceptable and I maintain the name *Spirorchis eustreptos*.

In the lung of Blanding's turtle, after dissecting seventeen specimens, I found one example of another worm which evidently belongs in this genus and which I name *Spirorchis emydis*. It is quite possible that this worm may have been lying in the blood vessels of the lungs, since Ward has clearly shown that his entirely similar *Proparorchis* is to be found in the blood stream.

Spirorchis emydis conforms generally to the shape and size of *Spirorchis eustreptos*, being very pointed at the head end, in fact, the small mouth, circular, subterminal and unarmed, is the anterior terminus, and from here the body widens to a point in front of the branching of the caeca. The body tapers at both ends and is widest at about the junction of the middle and posterior thirds of its length. The worm is of a very delicate structure which accounts for the condition of this specimen. The skin is smooth and unarmed. Immediately surrounding the mouth is a narrow circle or ring of white tissue before the cellular structure begins. The oesophagus extends posteriorly to join the caeca, in a quite crooked, torturous course, sharply bent before passing through the most striking structure of the body. There does not appear to be any pharynx proper and this structure which at first sight would undoubtedly be called a pharynx, is shown to be a large oval mass of tubules radiately arranged about the oesophagus and evidently emptying into it. Externally the tubules do not seem to be definitely limited but many of them fade away by being prolonged towards the surface on each side and disappear. They all, however, thus form an oval mass of cells through which the oesophagus passes. The whole tube may be said to be much bent and curved, especially before entering this mass, which is composed of about sixteen or seventeen of the tubules on each side. It seems quite conceivable that the function of this gland-like, radiate, structure may be to secrete a material analogous to that produced by leeches and serve to keep fluid the blood which the worm absorbs.

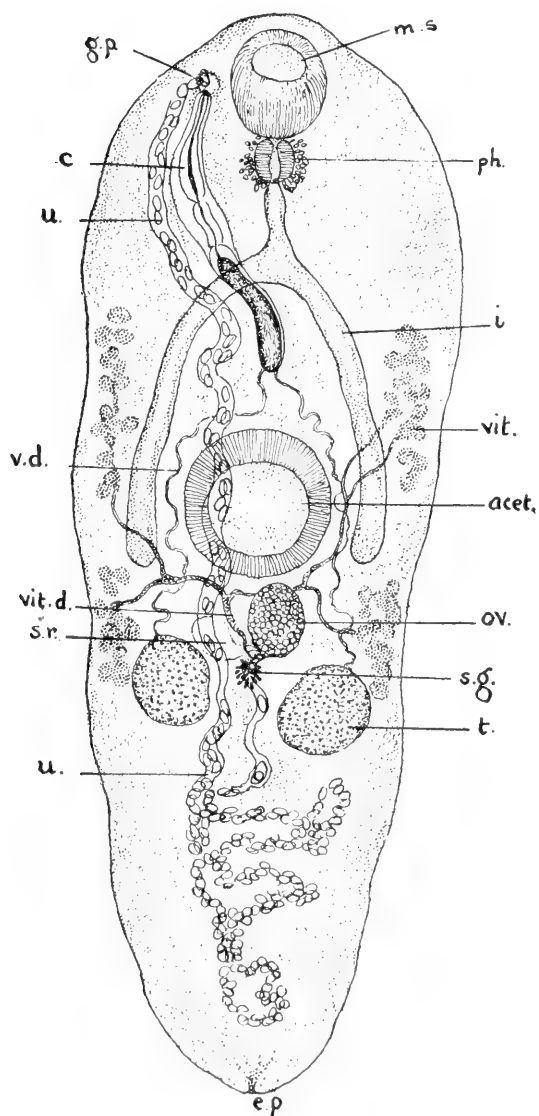
Posteriorly, and still surrounded by this glandular mass, the oesophagus empties directly into the coeca which pass in an irregular course to the posterior end of the worm. There, in this specimen, they appear to join but it is not possible to be quite sure. They are filled with black matter, probably partially digested blood. The testes are crushed but enough of them is present to show that they pursued a spiral course between the intestines from about the junction of the anterior and middle thirds of the length of the worm, to the ovary, only the seminal reservoir intervening. Only a portion of the seminal receptacle is left a little anterior to the ovary. All of the genital organs other

than the testes are situated near the posterior end of the body. The ovary is a lobulated organ composed, in this instance, of five principal lobes and one or two smaller ones. The oviduct is shown and also a part of the ductus seminalis but the genital pore cannot be made out, neither can Laurer's Canal. The excretory pore is present at the extreme posterior end of the body. The vitellaria are very abundant and extend on each side from the middle of the perioesophageal mass completely around the posterior end. Neither the cirrus nor the metraterm can be satisfactorily made out. The water vascular system may be seen in the form of small lacunae extending from the anterior to the posterior end terminating in a tube there. The margins of the worm are very delicate and this would lead one to think that in life the body is boat shaped as in the *Schistosomidae*. In my collection I have several specimens of a worm found in *Sphargis coriacea* which I have called *Pyclosomum sphargidis*, which in many particulars resembles *Spirorchis*. It is boat shaped and the arrangement of the anterior end about the oesophagus is very similar to *Spirorchis emydis*. It is a monostome and the genital organs except the uterus are situated very near the posterior end. Looss describes a worm from sea turtles which resembles the *Schistosomidae* in many particulars but he does not seem to mention those found in *Sphargis coriacea*. I have several of these and feel confident from the decided resemblance that they should be included in the above family.

In the case of *Spirorchis eustreptos* I am now satisfied that the worm should not be credited with a pharynx although in one of the three specimens the outline of a pharynx may be indistinctly seen in the position given it in the plate by the artist. None of these blood flukes apparently are possessed of the usual pharynx. I regret that I do not feel warranted in an endeavor to sketch the probable shape and position of the missing organs in this worm, such a proceeding would not be honest no matter how much my readers and I would be glad to have the worm complete.

Measurements of Spirorchis emydis:

Length	4.1 mm.
Width of widest part.....	.1 mm.
Width opposite pharynx.....	.4 mm.
Middle of body.....	.3 mm.
Diameter of mouth.....	.056 mm.
Length of pharyngeal mass..	.40 mm.
Width of pharyngeal mass...	.32 mm.
Tubuli in pharyngeal mass.	.120 mm. long \times .004 mm. wide
Diameter of ovary.....	.35 mm. \times .32 mm.

FIG. 100. *RENIFER NATRICIS*

Renifer natricis

(Fig. 100)

Host—Pilot Water Snake, *Natrix taxispilota*.

Habitat—Mouth.

Locality—Georgia; Zoological Park, New York.

Five of these small worms were found fastened to the mucous membrane in the mouth of the above snake and were with difficulty removed. It was first described by Rudolphi in 1803 under the name of *Fasciola ovata*. It was taken from a crow (*Corvus frugilegus*). Luehe 1899 described it under the name *Prosthogonimus* and seems always hitherto to have been found in a bird as host except on one occasion when it was found in a hen's egg in 1901 by Braun at Yeddo, Japan, and named *P. japonicus*.

The body is somewhat triangular in shape at least, it is wider at the anterior end than posteriorly. The subterminal mouth sucker is comparatively large and very strong, followed by a fairly large muscular pharynx, and around the external surface of which there are a number of glandular cells. The oesophagus is fairly long, and the coeca are short reaching only as far as the posterior edge of the acetabulum. The genital system is remarkably distinct and well developed. The testes are circular and placed opposite each other on either side of the body, posterior to the ovary which lies in the center of the body and very near the acetabulum. It is large and shows Laurer's Canal given off to the left side while the oviduct, given off from the posterior side, receives the duct from the seminal reservoir, and then the duct from the vitellaria before entering the shell gland. It then proceeds backward to form the coils of the uterus which fill the posterior part of the body. The water vascular system can be seen collecting from the anterior part of the body to escape at the posterior extremity through the excretory pore. The vitellaria with their ducts are very distinct. The seminal reservoir is situated between the right testis and the ovary. The uterus passes sometimes over the edge of the acetabulum on its way to the genital pore on the right side of the mouth sucker. The cirrus also after receiving the vasa deferentia separately at the base of its sac proceeds also to the pore.

Measurements of R. natricis.

Length	3.00 mm.
Width	1.20 mm.
Acetabulum520 mm.
Ovary20 mm.
Testes35 mm.
Mouth40 mm.
Eggs05 × .02 mm.

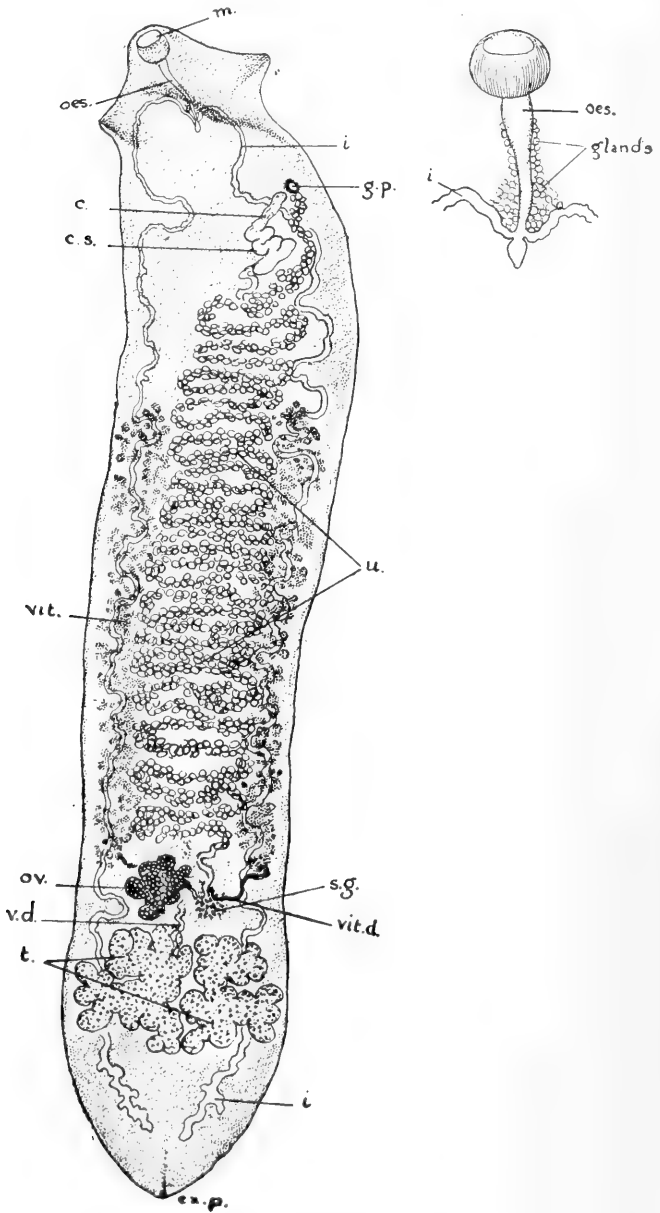


FIG. 101. *MONOSTOMA SPHARGIDIS*

Monostoma sphargidis

(Fig. 101)

Family *Monostomidae*, MonticelliHost—*Sphargis coriacea*, Leathery turtle.

Habitat—Intestine.

Locality—Off Gay Head, Massachusetts.

On July 18, 1919, a fine specimen of a Leathery turtle, *Sphargis coriacea*, Gray, was taken off Gay Head off the coast of Massachusetts. It had become entangled in the line of a lobster pot, thus rendering its capture easy. A mate was also taken in the same way a few days before and near the same place.

In the intestine were found nine of the above worms. They were all very near together, and some of them were still alive, but none were attached to the mucous membrane. Leidy found in 1856, 43 a worm in the above host naming it the t. h. *Sphargis coriacea*, and this worm *Monostomum renecapite* but he did not give a drawing of it. In 1858e, 327. Diesing found probably the same worm which he renamed *Nephrocephalum sphargis coriacea*. 1904a, 86 Brand in 1892b, found it in *Dermatochelys coriacea*. Braun 1893a, 915, 1899, 627-629, 1899b, 715, 721, 722, 1901b, 38, 52-53. Fig. 25 Monticelli 1892 685, 711, 714, 715. These are all the references I can find and as will be seen it is presumed that all are referring to the same worm, and yet in the absence of the literature and a good drawing of it, I am presuming to describe those found as I see them and to give a description and figure of one of them. They are nearly always seen in a curved position, that is with the tail pointing toward the head and lying on their side. The abdomen, too, is concave from end to end and also from side to side and they are flesh colored. The head is more or less of a graceful triangular shape with the mouth slightly subterminal. It is a good size and the sucker or bowl is cup-shaped and from its posterior part the oesophagus extends somewhat past the point where the coeca begin, forming a conical projection which is surrounded by small glandular cells shown in Fig. 2. The coeca are narrow and run in a very irregular course to terminate very near the posterior end of the body. In their course they present many short diverticula, especially on the outer aspect. They pass dorsal to the uterus, testes and much of the vitellaria. The vitellaria extend along each side for about the middle half of the length of each worm and terminate posteriorly opposite the ovary. The vitelline tubes extend from the end of each column to connect with the oviduct. The testes are two irregularly, deeply lobulated structures placed side by side and extending completely across the worm. The vasa deferentia arise apparently from the posterior surface of each testis and shortly connect to form the common vas deferens, which passes as a much coiled tube to the genital pore to terminate in the cirrus. It lays dorsal to the

uterus throughout most of its tortuous course. No seminal reservoir is seen, unless the small sac seen at the base of the cirrus is the reservoir, since it contains a quantity of spermatophores. The ovary is much lobulated, like the testes, but is small in comparison. It is situated anteriorly to the testes and toward the left side. It gives off the oviduct toward the left side, where it meets the vitelline ducts and then becomes the ootype surrounded by the shell gland. No Laurer's Canal can be certainly made out. The uterus, filled with small eggs contained in transverse coils, fills the major part of the body. The genital pore is situated anteriorly and to the left side of the body. There the cirrus may be seen presenting. The head is lobulated and appears to be armed with small spicules. The uterus lies to the outer side of the cirrus, emptying its egg contents at the genital pore. This worm, although three times as large *Pyelosomum coriacea*, will be readily recognized as belonging to the same genera but of a different species. There are many little peculiarities beside the difference in size, structure of head and clubbed end of the cirrus, etc., yet if not viewed critically the description of the one would answer for the other. It must be remembered, too, that they are both perfectly mature. The skin is thick, and although it is smooth throughout, it is composed of various muscular striae with small distinct cells placed at regular intervals, as seen in the side study. The body is thick and the skin is smooth throughout.

Measurements of M. sphargidis.

Length	18.00 mm.
Width, widest part.....	4.00 mm.
Testes, across	8.00 mm.
Ovary, across	5.00 mm.
Mouth, across	3.00 mm.
Eggs05 mm.

CESTODES

Dibothriorhynchus speciosum, sp. nov.

(Fig. 102)

Family—*Dibothriorhynchidae*, Ariola 1899d.

Subfamily—*Dibothriorhynchinae*, Mont. 1892v.

Genus—*Dibothriorhynchus*, Blainv. 1824a.

Host—*Mycteroperca venenosa*.

Habitat—Encysted on the intestines.

Locality—New York Aquarium.

This worm was taken July 10, 1916, from a cyst found under the peritoneum covering the intestine and there were a large number of these cysts so that twenty of these worms were taken from one fish. They are quite large, being from 20 to 22 mm. long \times 2 mm. wide. The head is a very beautiful structure, being composed of two large bothria from between which four proboscidae emerge. These are very large and covered densely with good sized hooks which are .040 mm. long, and the proboscidae may protrude as much as 2 mm. The bothria measure across .720 mm. and about the same length. The muscular bulbs are short and wide.

These immature worms are found in a great number of other fish such as the Spanish mackerel, blue fish, striped bass, weak fish, etc. Among the Bermuda fishes they are very common.

Dibothriorhynchus xiphiae, sp. nov.

(Fig. 103)

Host—*Xiphias gladius*.

Habitat—Encysted on the intestines.

Locality—Wood's Hole, Mass.

This very unusual specimen was found while examining a sword fish at Wood's Hole in August, 1917. It was found encysted in the peritoneum covering the intestine, in a large mass. The head is composed of two large and wide bothria and from between them protrude at the convenience of the worm four long proboscidae which are armed with an immense number of hooks. These proboscidae, as in all other members of this genus, can be retracted within the irregularly curved canals by means of four large muscular bulbs at the posterior end of the anterior portion of the worm. The one peculiar thing about this worm is the presence of numbers of calcareous globules in the whole anterior portion of the worm, filling all that portion where the canals are situated. The only notice that I can find of this worm

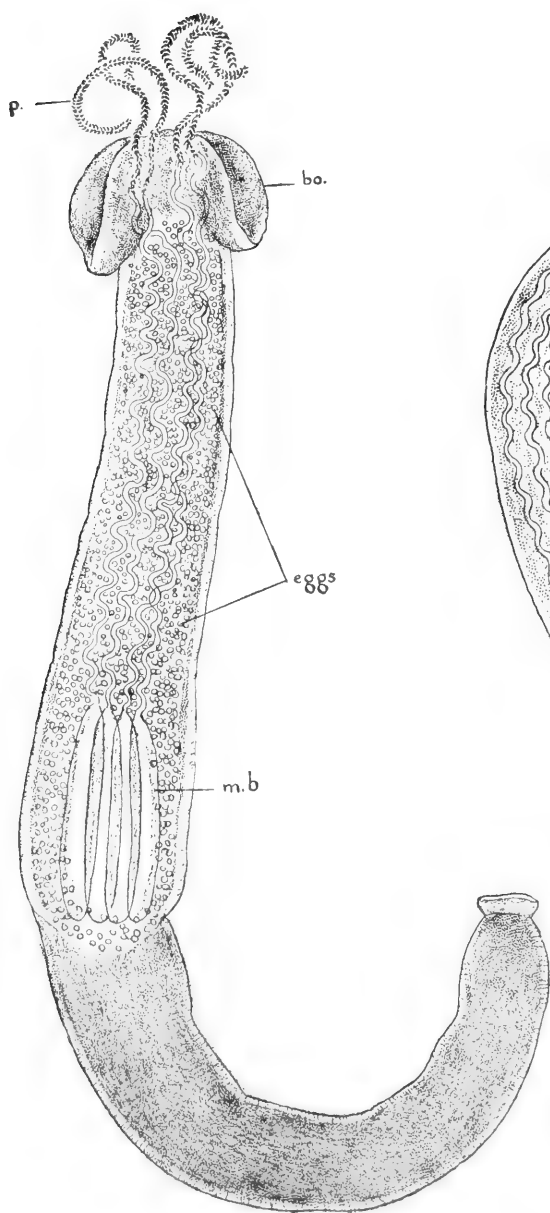


FIG. 103.
DIBOTHRIORHYNCHUS XIPHIAE

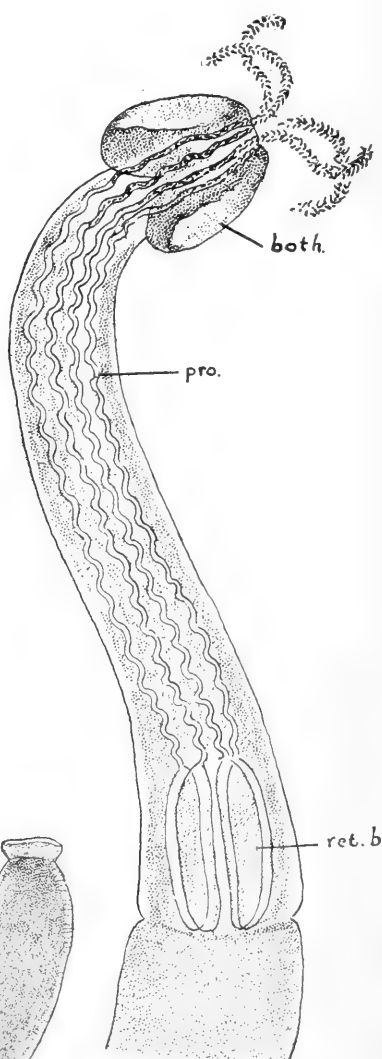


FIG. 102.
DIBOTHRIORHYNCHUS SPECIOSUM

in the above host is, Rud. in 1819-R. attenuatum, and by Linton in 1897a and 1900a-248 and in 1901b 412, 448. Stiles and Hassall do not credit these guests with *D. xiphiae* as host, I think.

The worm is much larger than usual, but with no other peculiarity.

As the food of the sword fish is largely squid and some other small fish, as menhaden, but principally squid, the life history of the present form might yet be found there if looked for. This is the first of this species which I have ever seen.

Measurements of *Dibothriorhynchus xiphiae*

Length	1 inch
Width at neck.....	1.4 mm.
Width across bulbs.....	2.0 mm.
Width of head.....	2.4 mm.
Length of larger hooks.....	.040 mm.

Dibothriorhynchus balistidae, sp. nov.

(Fig. 104)

Host—*Balistes carolinensis*.

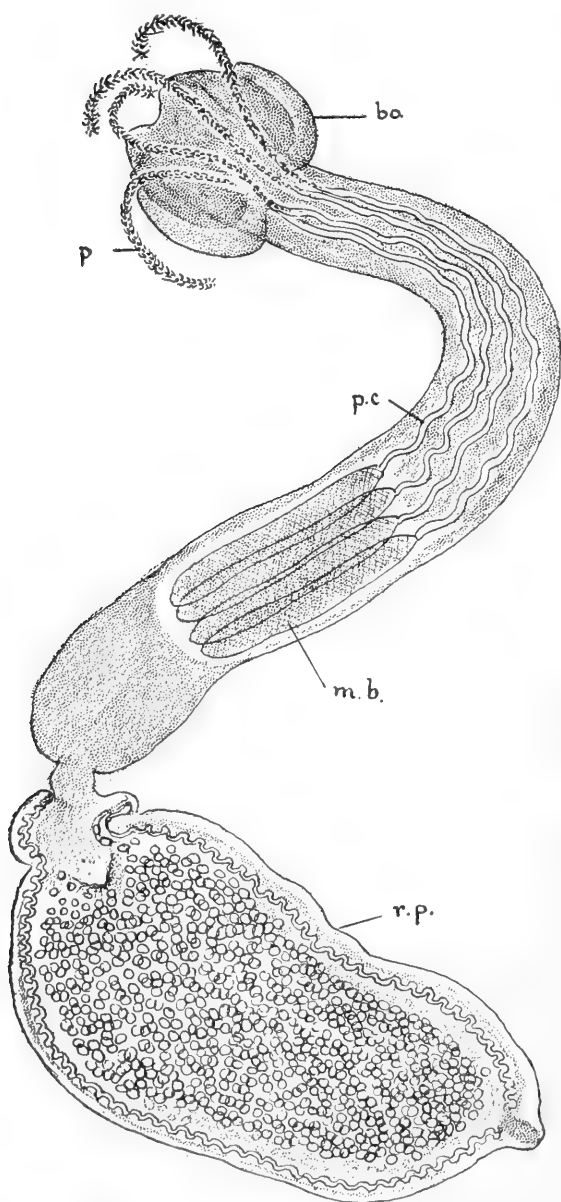
Habitat—Encysted on intestine.

Location—New York Aquarium.

This unusual specimen was found while examining a trigger fish on April 28, 1916. *Dibothriorhynchus* was named by Blainville in an appendix to Bremser in 1824a, 519, under the name *Dibothriorhynque*, and several species have since been described by different authors. These worms are usually found encysted in the body of their host, where in a blastocyst they assume the shape as given in the Fig. 104, and where they remain until they are eaten with their host by another fish, the next host. In this Fig. 104 the artist has shown a partially organized cyst attached to the posterior end of the specimen. This, in the first place, is wrong in being shown as partly developed, and filled, as he thought, with eggs. The supposed eggs are probably merely calcareous bodies, and the cyst attached is very unusual and should be merely a plain sac.

Measurements of *D. balistidae*.

Length	6.00 mm.
Width60 mm.
Length of bothria.....	1.00 mm.
Width of bothria.....	1.00 mm.
Length of sac.....	3.20 mm.
Width of sac.....	1.40 mm.
Large hooks on proboscidae, of which there are six rows.....	.40 mm.

FIG. 104. *DIBOTHRIORHYNCHUS BALISTIDAE*

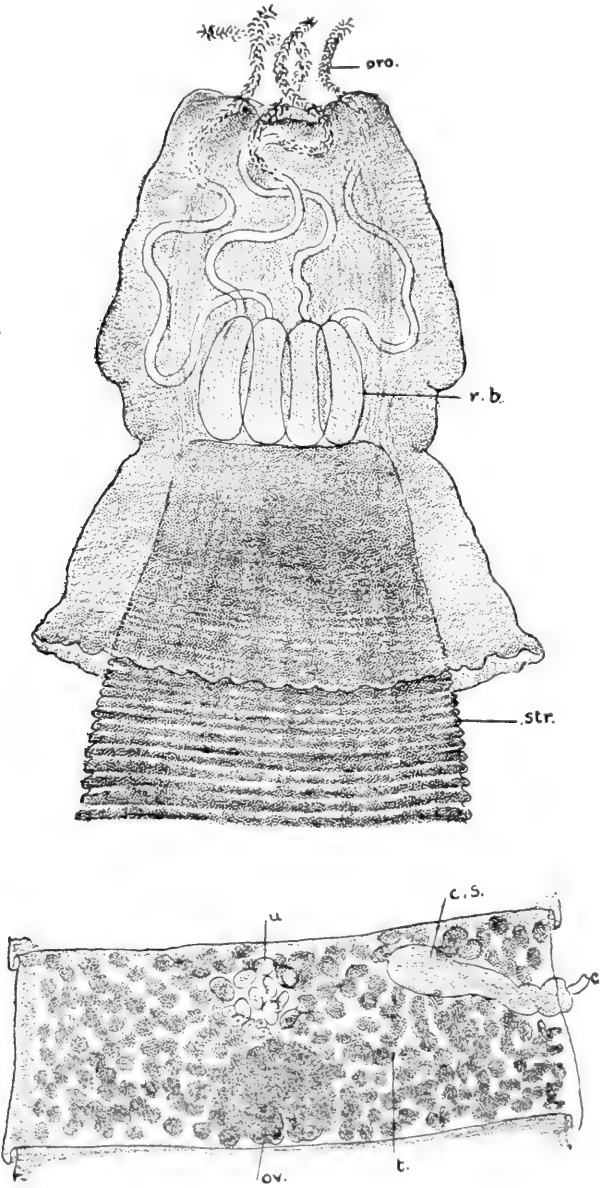


FIG. 105. *TETRARHYNCHUS BISULCATUS*

Tetrarhynchus bisulcatum, Linton, 1889.

(Fig. 105)

Family—*Tetrarhynchidae*, Cobbold, 1864b.Subfamily—*Tetrarhynchinae*, Loennb, 1899a.Genus—*Tetrarhynchus*.Host—*Cestracion zygaena*.

Habitat—Stomach.

Locality—Wood's Hole, Massachusetts.

On July 30, 1915, during the examination of a large hammer-head shark, a lot of the above worms were found with heads embedded in the mucous membrane of the stomach. It may be said that the tissues surrounding the parts attacked were much irritated and swollen. The worms were not as large as those found on some occasions by Linton, who describes one which was 150 mm. long. The largest of these was 25 mm. long \times 2 mm. wide. Many were broken, however, and they may have been parts of much larger worms. The remarkable feature about this worm is the head, which is more or less quadrangular, containing four muscular bulbs which control the proboscidae which are attached to them. These are four in number, but are not long and the hooks are quite small. Posterior to the head, however, and attached to it is a skirt-like structure which is scalloped about the free edge in a very fanciful manner. It extends from the base of the four muscular bulbs to a point nearly as far from the bulbs as the base of the bulbs is from the anterior end of the head. At the posterior edge it flows out somewhat from the strobila which it encloses. It is thin and semi-transparent and what its use, is not known.

The strobila is composed at first of short segments, but they gradually increase in length, until they are half as long as wide. It begins by a square margin at the base of the retractile muscular bulbs. The lateral margins are imbricated and the genital pore is seen about the middle of the margin or a little anterior thereto. It is situated on either side. Near the anterior margin of the segment and about the middle may generally be seen a cluster of oblong yellow eggs which are very near to what appears to be an opening of the uterus as in the *Dibothriocephalidae*. The testes are large and numerous, and the cirrus sac is large and often presents the cirrus protruding. The ovary is a solid rounded mass near the middle of the posterior edge of the segment. It is composed of two lateral masses joined by a narrower portion. The vitellaria and shell gland cannot be easily seen, so as to separate them from the ovarian mass. This is probably a perfect worm of a large genus, provided with armed proboscidae. It is an adult worm.

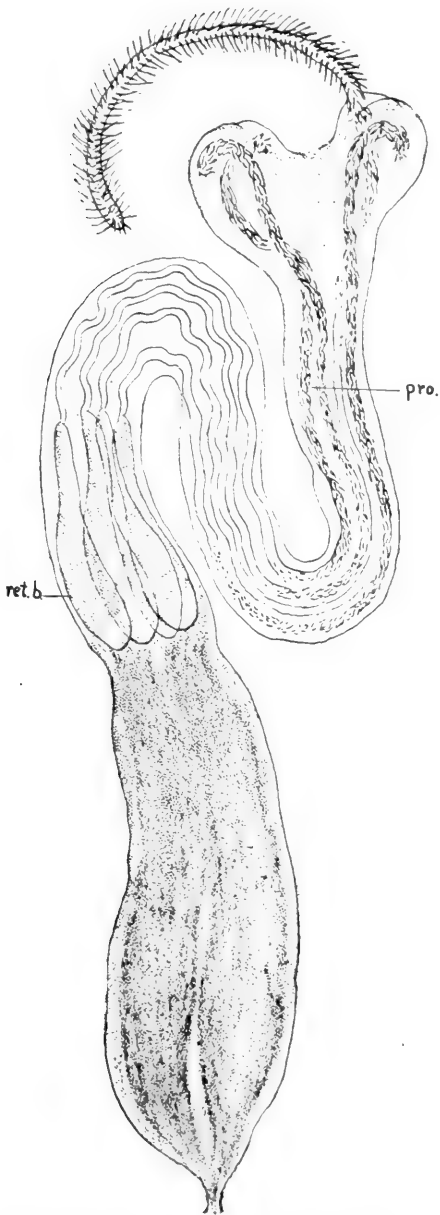


FIG. 106. *SYNBOTHRIMUM HEMULONI*

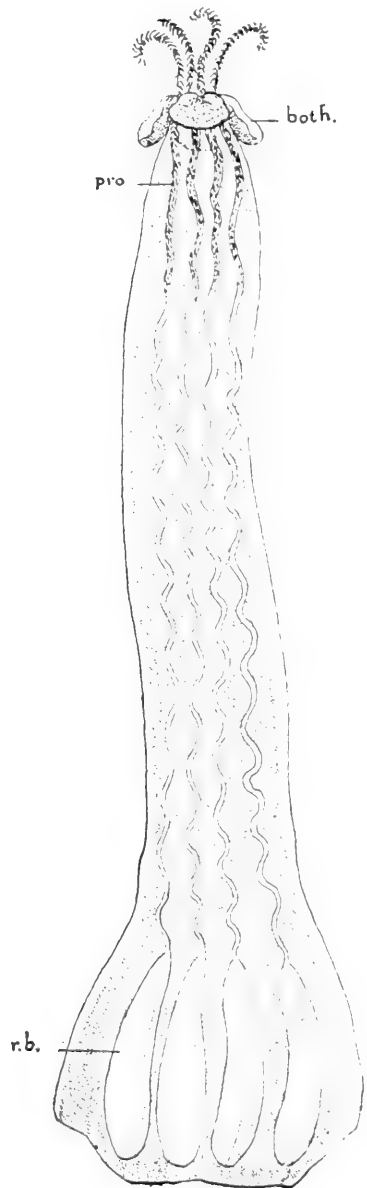


FIG. 107. *TETRARHYNCHUS BREVIBOTHRIA*

Measurements of T. bisulcatum.

Length.....	from 25 mm. to 150 mm.	..
Width.....	from 2 mm. to 3 mm.	
Width of head anteriorly..	.560 mm.	
Width of head posteriorly..	.640 mm.	
Length of head.....	.800 mm.	
Length of sheath or skirt..	.520 mm.	
Width of sheath or skirt at bottom	1.16 mm.	
Eggs040 mm. \times .030 mm.	
Length of ripe proglottids...	.500 mm.	

Synbothrium hemuloni, sp. nov.

(Fig. 106)

Host—*Hemulon plumieri*.

Habitat—Gullet.

Locality—New York Aquarium.

Found in a cyst in the thyroid gland of a *Hemulon plumieri*, white grunt, from the Aquarium, New York, on March 9, 1917.

The cyst also contained a quantity of yellow cheesy matter, beside the usual blastocyst which, in this case, was sacculated and very long, being 30 mm., while the worm or larva itself was only 4.50 mm. in length and .40 mm. wide. The proboscidae are very different from any observed, being covered with at least five rows of comparatively very long, thread-like spines, which are slightly crooked and pointed. There are no hooks whatever, but, as usual, there are at the base of the long spines numerous short spines. Three of the proboscidae are not protruded and the spines are seen neatly packed along the core within the tube. In order to become the perfect adult worm, the host must be eaten by a proper future host and the cyst, etc., digested so as to release the larva. The future host is unknown.

Tetrarhynchus brevibothria, sp. nov.

(Fig. 107)

Host—Red Snapper, *Neomaenis aya*.

Habitat—Thyroid gland.

Locality—New York Aquarium.

On May 5, 1916, there were found encysted in the thyroid gland of a red snapper several *Tetrarhynchus*, in fact these have been found in the same location and nowhere else on several occasions. The

worms may therefore be considered probably peculiar to that fish and to the odd location.

The life history of this cestode is not known. The egg has not been seen nor has the strobila, indicating the adult form, been yet observed. It is odd among the numerous Tetrarhynch in that the head or anterior end is so small in comparison with any other known. The bothria too are very different, as there is on each side a cup-like bothrium or sucker, while on the anterior and posterior sides that which stands for a bothrium is not a sucker at all but merely a semi-circular flap-like process both of which are covered thickly with minute spines. The backs of the cupped bothria are also covered with these small spines.

The proboscidae are covered thickly with very numerous hooks, some very large and powerful, while the greater number are merely long, crooked spines. The proboscidae are comparatively short and thick, while the tubes to which they belong are long and terminate in relatively large muscular retractile bulbs. The large hooks located chiefly along the inside of the bend of the proboscis and the spines and other smaller hooks along the outside. At the base of each proboscis, the spines are so profuse that they look like coarse hair.

Measurements of T. brevibothria

Length	8.00	mm.
Width at base	1.60	mm.
Width of head65	mm.
Length of hooks from point to bend...	.056	mm.
Length of hooks from bend to base...	.040	mm.

The spines vary in length.

Rhynchobothrius aetobati, sp. nov.

(Fig. 108)

Genus—*Rhynchobothrius*, Baird 1583a.

Host—*Aetobatis narinari*.

Habitat—Spiral valve.

Locality—Singapore.

In July, 1916, this interesting worm was found in a large spotted ray in limited numbers and several studied. The largest body found is about forty-five millimeters. Some were found loose, but most of them were attached with their proboscidae sunken through the mucosa and followed by the head. The proboscidae seemed to spread out under the mucosa, but could not certainly be said to have pierced the submucosa. Also, many were broken in trying to extricate them. One peculiarity is that there were many ripe proglottids, which were

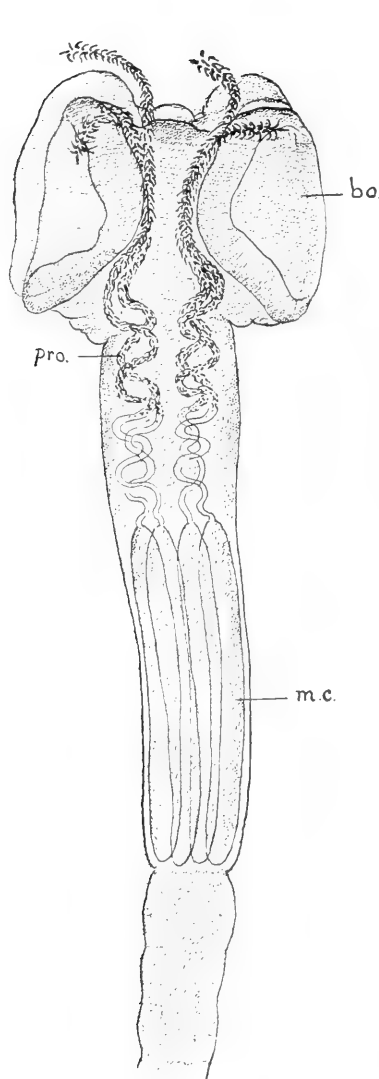


FIG. 108.
RHYNCHOBOTHRUS AETOBATI

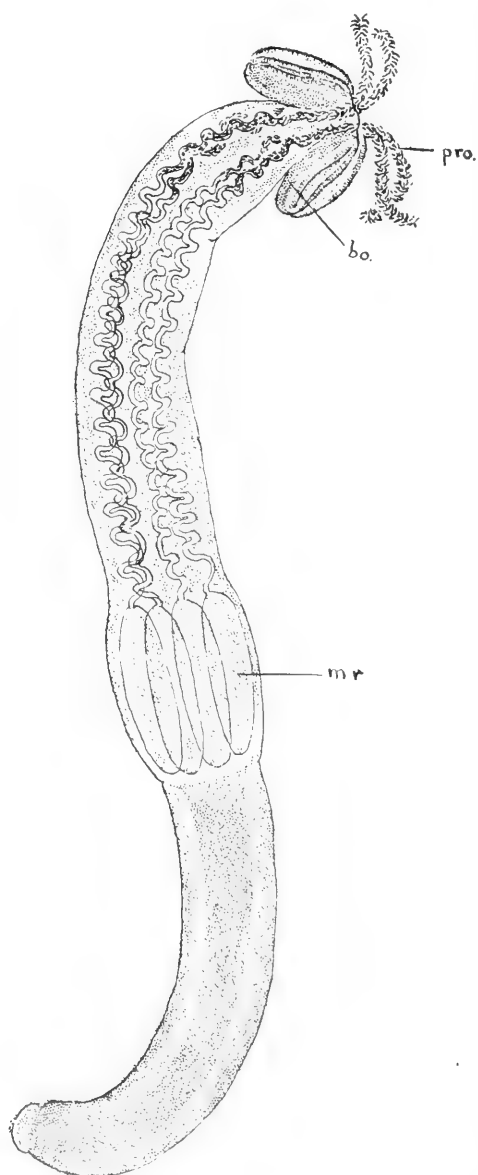


FIG. 109.
RHYNCHOBOTHRUS CHIRONEMI

credited to this worm, for no other worm as large was found in the spiral valve at this time. A description of these is given later.

The adult worm has a comparatively large head, much wider than any other part of the body. It is composed of four large, deep bothria, and between each pair of them is a more or less conical mass, for which no particular function can be conceived. Each pair of bothria seem to have their own pair of proboscidae, which are not very long, although they are much coiled while still in their containing tubes. The muscular contractile bulbs are extra long and powerful looking. The hooks on the proboscidae seem to be arranged in four rows of large hooks with several rows of smaller ones intervening. The large hooks are very much curved and fixed to a wide strong base, and from the posterior margin of this base to the centre of the bend of the hook is 0.160 mm. and from that to the point 0.080 mm. The bend is a semi-circle. The root or base of the hook is 0.080 mm. wide, and the width of the protruding proboscidae, including the hooks of course, is 0.240 mm. The strobila at once begins at the muscular bulbs, to be striated. The segments are very short at first, but at the end of the broken worms I have, they are 2.08 mm. long. After being thrown off, they measure 6 mm. long \times 1 mm. wide. While showing the cloaca and organs at one end, the main structure is a long sac literally filled with eggs, which are 0.032 mm. in diameter.

Measurements of R. aetobati.

Length	90.00 mm.
Width	1.44 mm.
Head	1.40 mm. \times 1 mm. long.
Width of neck.....	1.36 mm.
Length of head and neck, including muscular bulbs.....	3.00 mm.
Eggs, round diameter.....	.024 mm.
Ovary, from side to side.....	1.92 mm.
Ovary, antero-posterior diameter	1.28 mm.
Shell gland, diameter.....	.560 mm.
Length of segments.....	7.00 mm. \times 2.40 mm.

Rhynchobothrius chironemi, sp. nov.

(Fig. 109)

Host—*Chironemus moadetta*.

Habitat—Encysted on liver, stomach, etc.

Locality—Singapore.

On July 19, 1916, a large number of these parasites were found encysted under the peritoneum over the liver and stomach of the fish *Chironemus moadetta*. They are almost exactly of the same structure

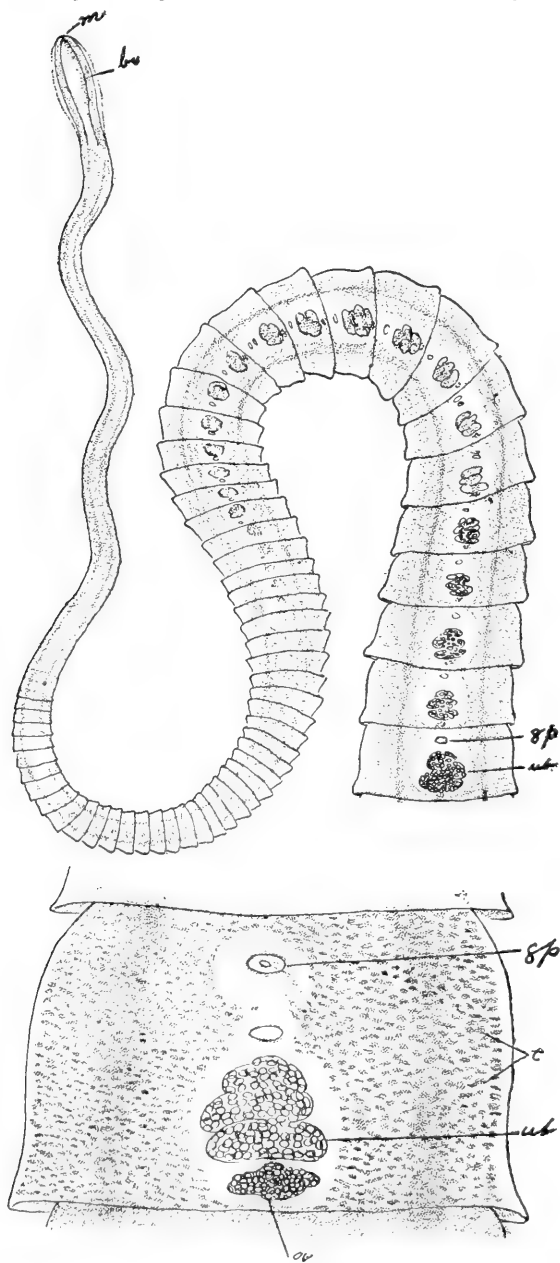


FIG. 110. *DIBOTHRIUM TANGALONGI*

as other *Rhynchobothridae* except that on the edge of the bothria throughout, they are bordered with fine spicules, in fact almost like hair of a more or less equal length, and it has only two bothria. The muscular retractile bulbs are short, but the tubes for the proboscidae are long.

Measurements of D. chironemi

Length	8.00 mm.
Width68 mm.
Longest hook on proboscidae.....	.034 mm.
Across head896 mm.

Dibothrium tangalongi, sp. nov.

(Fig. 110)

Host—Tangalong, Civet Cat.

Habitat—Stomach and intestines.

Locality—Moerateweh, Borneo.

This interesting worm was found in the intestines of a Tangalong, a sort of civet or musk cat, at Moerateweh, Borneo on June 25, 1916. There were a large number of these worms, and as they present an unusual form, especially of the head, a record is made. A typical adult is about 5 inches long with a maximum width of 5 mm. Across the tip of the head it is .1 mm. and a short distance posterior to this it is \times .25 mm. wide. The whole length of the bothria is .70 mm., the posterior end of the groove gradually becoming very shallow, until it disappears. For the anterior 4 cm. of the neck, it is very narrow, and half of this length is devoid of transverse striae. Then it becomes imbricated and shows a number of water vascular ducts, but no sign of genitalia until about the beginning of the posterior half of the length of the worm. Then the usual two central apertures appear. The anterior one near the margin of the segment for the cirrus, and the one in the middle of the segment, the genital pore or the uterine pore. The eggs are clumped together in a more or less condensed mass in the middle of the segment and quite within the lines of the two large aquiferous ducts. The testes are very numerous and fill up much of the rest of the segment. The vitellaria are in the form of a small mass posterior to the cluster of eggs and ovary. The segments are rather bell-shaped with smooth lateral margins but strongly imbricated. They are, when mature, bell-shaped and overlap one another. They measure 1 mm. long \times 3 mm. in width. Eggs measure .02 mm. \times .04 mm.

There were also a great many *Ankylostoma* in the host's intestines and they were often attached to this worm.

Tylocephalum pingue, Linton

(Fig. 111)

Host—*Aetobatis narinari*.

Habitat—Spiral valve.

Locality—Singapore.

On July 20, 1916, there were found in the spiral valve of a large spotted ray, *Aetobatis narinari*, a single worm fixed by the head in the mucous membrane. Luckily, when removed, the worm came away whole and it is here shown. No others were seen. Linton in 1890 described a single specimen, which in a general way seems to have been a worm very like this. He found it in the spiral valve of a cow-nosed ray, *Rhinopterus quadriloba*. Although from a different host and, geographically, very far away, it still may be of the same genus and species. This worm is a perfect adult and there can be no question about the form which has been very carefully drawn. The head is a little different from *T. pingue*, since it is not adorned with a collar or two straps on the front of the head between the suckers. Linton also describes a *Tylocephalum marsupium*¹ from a sting ray², but this has less resemblance to the present worm than *T. pingue*. As this worm is an adult and perfect, I shall try to describe it and that with the plate should clear up matters. Like *T. pingue*, it is 20 mm. long \times .60 mm. wide at its widest point. The head, as may be seen, is composed of two parts, the head proper and a large semi-globular myzorhynchus, which protrudes from the terminal portion of the head. The whole head is .50 mm. in diameter at its widest part, but including the myzorhynchus its antero-posterior diameter is a little less, and as has been said, there is no roll or collar between the head proper and the myzorhynchus. Depth of myzorhynchus is .20 mm. On each side of the head proper is seen a sucker which is comparatively quite large .09 mm., and beside, each seems to have a few small spines around it, so also has the myzorhynchus small spines at its periphery, and possibly all over its surface. As the head is quite transparent, the myzorhynchus is seen to be not round, as shown in *T. pingue*, it is not more than hemispherical. The neck is large and the striations of beginning segments are seen very near the head. The worm, without staining, is of a buff color, and the strobila begins to display developing internal organs at about one-third of its length from the head and is imbricated throughout. The ripe proglottids are about .70 mm. to 1.25 mm. long and .40-.50 mm. wide. At the posterior end, the ovary is located and the genital pore is irregularly alternately lateral and opens near the junction of the anterior and middle quarters of the segment. The cirrus sac is large, and the cirrus is sometimes seen slightly protruding. The segment, when quite mature, is nearly filled with comparatively large testes. The vitellaria are plentifully placed along each margin.

¹ Notes on Entozoa of Marine Fishes of New England with Descriptions of Several New Species. Part II.

² Notes on Two Cestodes from the Spotted Sting Ray. Jour. Parasitol. Sept. 1916.

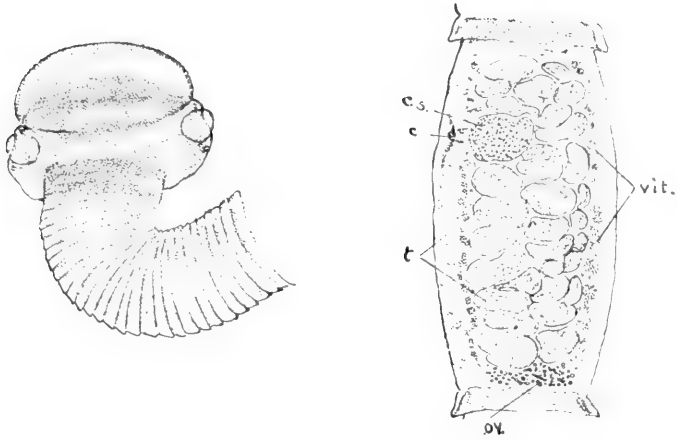


FIG. 111. *TYLOCEPHALUM PINGUE*

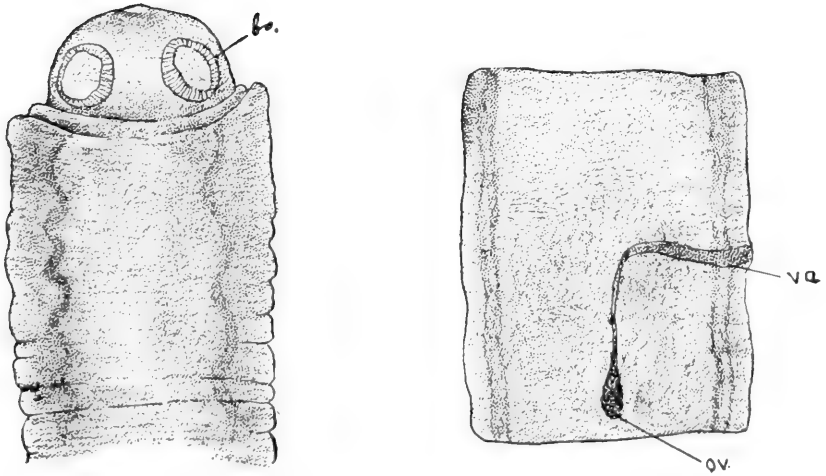


FIG. 112. *TAENIA FARANCIAE*

Taenia faranciae, sp. nov.

(Fig. 112)

Host—*Farancia abacura*, Mud Snake.

Habitat—Stomach and intestines.

Locality—Zoological Park, New York.

On August 23, 1918, during the examination of a specimen of the above reptile, I found in the stomach and intestines great numbers of a peculiar *Taenia*. It is about 100-120 mm. long and 1 mm. wide. The body is exceedingly thin and difficult to handle without breaking, and for the first third of the length of the worm there are no signs of a genital apparatus, and even towards the posterior end of the strobila the organs are difficult to make out. An ovary, uterus, and vagina are fairly well defined, but the cirrus and vas deferens cannot be seen. The genital cloaca occurs irregularly on either side of the strobila at intervals of about 20 mm., but no division of the strobila into segments can be made out. The head is capable of being withdrawn within the anterior end of the strobila. (Fig. 112.) When it is protruded as far as possible, the head is almost perfectly round and presents four unarmed suckers, and on the extreme anterior portion of the head is a slight eminence. There is a very decided neck, and while the margins of the strobila are somewhat irregular, no division into segments are to be seen although some lines across are shown. (Fig. 112.) The water vascular system is pretty plain, to be sure. It may be said that the specimen is not an immature worm for a number of the largest were examined and all found alike. The head is .60 mm. across and the suckers .20 mm.

Taenia chelodinae, sp. nov.

(Fig. 113)

Family—*Hynemolepididae*, Railliet & Henry, 1909.Genus—*Hymenolepis*, Weinland, 1858.Host—*Chelodina longicollis*.

Habitat—Intestine.

Locality—Australia.

On September 6, 1918, in the intestine of a very old turtle, *Chelodina longicollis*, from Australia, there was found a very interesting small *Taenia*. It was still alive when found and its movements were quite interesting. The head, which in general outline is a long oval, is square across its anterior end, which contains an opening, and immediately behind this the rostellum is armed with a peculiarly arranged cluster of hooks. They are fixed in the hollow base of a pear-shaped body, the point of which extends backward behind the four suckers. The hooks appear to be about twelve or fifteen in number,

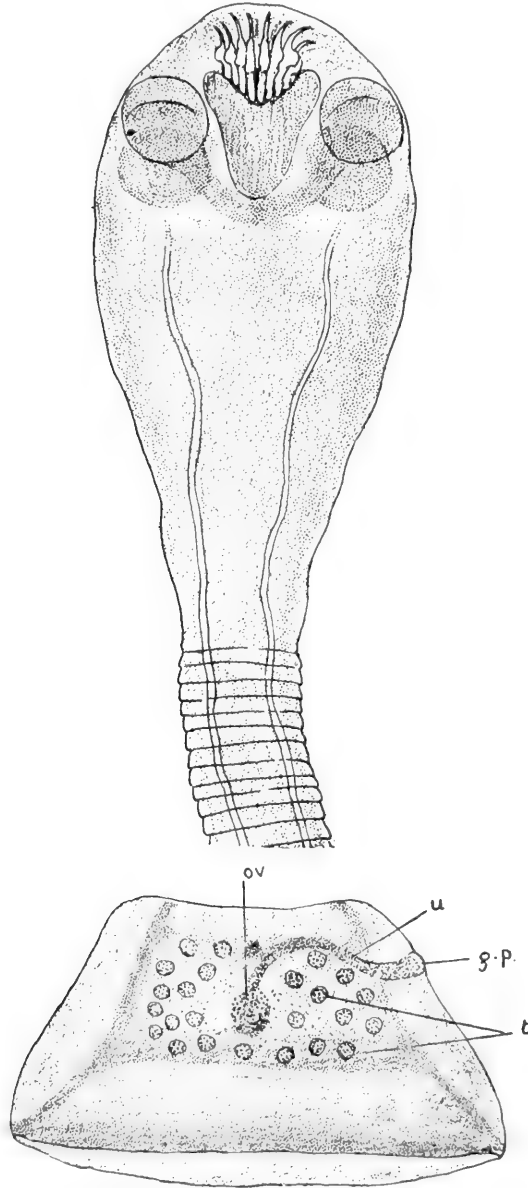


FIG. 113. *TAENIA CHELODINAE*

are very strong with strong clubbed bases and are much curved and all pointing outward. On each side of the pear-shaped body is a good sized sucker, four in all, and they appear to be joined by a muscular band which winds from side to side just beyond the apex of the pyriform body. Behind the suckers, the neck and body for a short distance are devoid of any particular structure except a water vascular duct on each side which extends forward almost to the suckers. A short distance posterior to the head, however, the body becomes striated. The striations are from the beginning rather long and measure .1 mm. the edges overhang each of the following sections, and as the segments become wider and more developed they become quite cup-shaped, but do not show the genital organs until well towards the end of the strobila, where they show the ripe segments to be deeply cup-shaped and fitting deeply into each other. The testes are relatively large but not numerous, the ovary being situated near the middle of the segment and the vagina passing in an arched direction outwardly to near the anterior portion of the margin. The cirrus also makes its way to the genital outlet at this point in front of the vagina, and this cloaca is apparently always on the same side.

Measurements of T. chelodinae

Length	4 inches or 100 mm.
Width	1.00 mm.
Length of head	1.30 mm.
Width of suckers20 mm.
Length of pyriform basis of hooks	.35 mm.
Width of pyriform basis of hooks	.30 mm.
Length of central and longest hooks25 mm.
Length of segment near head....	.01 mm.
Length of ripe segment70 mm.

Dibothrium microcephalum, Rud. 1819a.

(Fig. 114)

Host—*Mola mola*.

Habitat—Intestine.

Locality—New York Aquarium.

On June 5, 1918, a sunfish, *Mola mola*, Linnaeus was brought to the New York Aquarium for sale. The fish was still alive, and Director Townsend, always keen to furnish specimens to create wonder for the numerous visitors to the Aquarium, bought it but was disgusted when it soon died. The fish weighed about 200 pounds although specimens have been taken weighing as much as 1000 or 1200 pounds.

On examination the skin as usual had a number of ectoparasites attached to it. There were several *Tristoma mola* and some Copepods.

In the stomach there were a lot of *Taenia* tangled together forming a mass as large as one's fist. These were separated and proved to be clearly two different species of *Dibothria*. Rudolphi, who named and described one of these worms, called it *Dibothrium microcephalum*, (Diesing Syst. Helm. 1592), while Leuckart named it *Bothriocephalus sagittatus*, (Zool. Bruchst. 39, Pl. 1, 15). Both apparently describing characteristics belonging to two worms as the chief features of *D. microcephalum*. Linton gave a very full description of the worm in "Notes on Entozoa of Marine Fishes of New England." Indeed I would refer to his careful measurements of both of his varieties. I have no doubt they are right, although the size of the worms which he examined were much larger evidently than those described here. It may be that many of the specimens in my possession are young ones, for many are seen without developed genitalia. The peculiar thing about the descriptions of these worms is that while all of the writers noticed that certain individuals were different from others, they still adopted the name *D. microcephalum*, Rud. as the name by which the worms were to be known, although they are as different in almost every respect as it is possible to be. It is true that Leuckart gave it the name *D. sagittatus* but does not seem to have distinguished which form he referred to. Linton had very grave doubts about both worms being of one species and satisfied himself by calling one "Var. A" and the other "Var. B" of *D. microcephalum* and he says, "I have experienced much difficulty in reconciling differences between my specimens and previous descriptions. While I have little doubt but that the specimens in question are specifically identical with those figured by Wagener and Leuckart, there remains much to be desired in the way of a detailed description of the animal," and again he says, "One might indeed be justified in separating them yet further and calling them distinct species, if the same sharp distinction is observed as in other collections."

Under ordinary circumstances, on seeing and comparing the large number of individuals found in the *Mola* in question, one would not have the least doubt about the fact that there were two species of *Dibothria* among them. To more strongly emphasize the truth of this, I have made accurate sketches of both worms found in the *Mola* of June 5, 1918, and these again have been reproduced by a competent artist, using good specimens of both in alcohol and also mounted, stained with acid carmine. The one, as will be observed, has a head with two long narrow bothria and with a small button-shaped apex or rostellum. As this is the smaller head, I take it that Rudolphi called it *D. microcephalum*. The strobila of this worm is also very different from that of the other which I propose to call *Dibothrioccephalus mola*. The segments are long and flare out at the posterior end like a trumpet, to enclose the following segment. This narrow portion of the strobila is about half the length of the worm and the segments are very irregu-

lar in shape and show no organs. The worm by measurement of a number of specimens was found to be about 4 inches in length \times 1.20 mm. wide.

In the posterior wider portion the segments are short and the lateral margins very irregular. The genital pore is irregularly bilateral and generally opens near the middle of the margin. The cirrus is often seen exerted. The uterus opens ventrally.

Measurements of D. microcephalum.

Length of worm	4 inches
Width of widest part of strobila	1.3 mm.
Length of head90 mm.
Width of head35 mm.
Length of rostellum15 mm.
Width of rostellum25 mm.
Length of bothrium50 mm.
Length of first segment50 mm.
Width of segment next head12 mm.
Width of base of same segment30 mm.
strobila same shape, but some of them as much as, in length.....	1.00 mm.
Narrow portion of the strobila length.....	.290.00 mm.
Length of wide portion of strobila.....	.135.00 mm.
Eggs05 \times .07 mm.
Testes7 \times .6 mm.
Width of ripe segment.....	1.00 mm.

Dibothriocephalus mola, sp. nov.

(Fig. 115)

Family—*Dibothriocephalidae*, Luehe, 1902n.

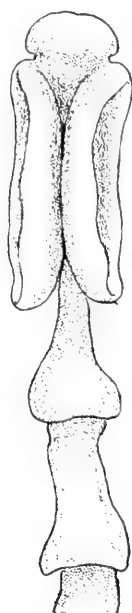
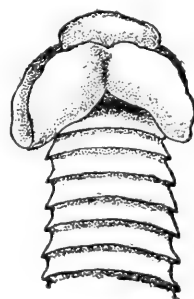
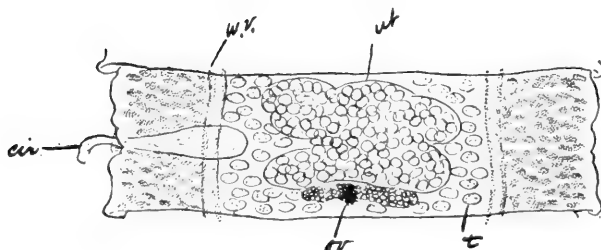
Host—*Mola mola*.

Habitat—Intestine.

Locality—New York Aquarium.

Several specimens of this worm were found in the stomach of a *Mola* on June 5, 1918, associated with a lot of specimens of *Dibothrium microcephalum*, Rud.

This worm is a much larger worm in every way than *D. microcephalum*. It measures 20 to 24 inches in length by 5-6 mm. in width. About .50 mm. of the anterior end is cylindrical, stiff and generally of a brownish color, and it is closely imbricated. The head which surmounts this portion is more or less square, although it is wider across the posterior portion of the bothria than in front. The rostellum is rather square shaped, much larger than that of *D. microcephalum*. The

FIG. 114. *DIBOTHRIUM MICROCEPHALUM*FIG. 115. *DIBOTHRIOCEPHALUS MOLAE*

bothria are short and rather cup-shaped cavities with the edges crenulated or crumpled, and in no instance were they found elongated and smooth, so commonly seen in other dibothria. There is not in any specimen to be seen any neck, the imbricated segments which are about one-fifth to one-tenth as long as wide, extend quite up to the bothria, and the strobila does not show any formation of genitalia until toward the end of the strobila. The water vascular system is distinct throughout, beginning at the head. The genital pores are irregularly bilateral and the cirrus is often seen external. The cirrus pouch is flask shaped and fairly large and sometimes showing the vas deferens and cirrus coiled within it, as well as outside. The lateral margins of the segments are deeply and irregularly notched and the genital pore opens on the lateral margin about the middle of the segment. It will be noticed that the lateral margins of the segments are quite different from those of *D. microcephalum*, in which they are smooth and sharply imbricated, while in *Dibothriocephalus molae* the margins are very irregular and deeply indented. The uterine opening is ventral. The vagina can be made out in many segments posterior to the cirrus pouch and cirrus. The testes are fairly numerous, but are chiefly confined within the boundaries of the water vascular ducts, and they are comparatively large. The mass of roundish eggs in the uterus seems confined to the centre of the segment and the ovary lays along the posterior margin of the segment.

Measurements of Dibothriocephalus molae.

Length	20 to 24 inches
Width	5 to 6 mm.
Width of head across bothria.....	.20 mm.
Length of bothria.....	.20 mm.
Across head just back of rostellum.....	.20 mm.
Width of first segment of strobila.....	.21 mm.
Length of each segment near head.....	.201 mm.
Eggs05 × .07 mm.
Testes9 × .12 mm.

Taenia dysbiotos, sp. nov.

(Fig. 116)

Host—*Aetobatis narinari*.

Habitat—Spiral valve.

Locality—Batavia, Java.

On May 25, 1918, this worm with others was found in the large spotted ray, *Actobatis narinari*, at Batavia in the Island of Java. As the name indicates, the life of this fish must be made miserable by the numerous and various parasites of its spiral valve.

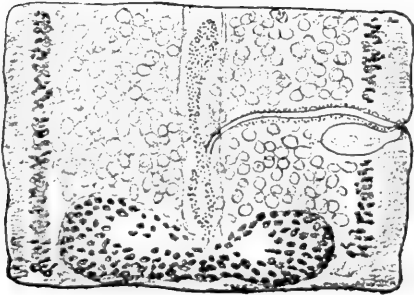
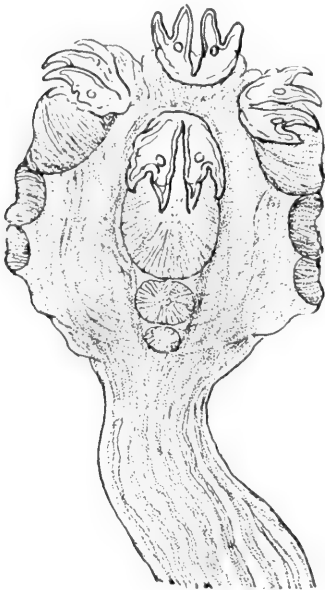


FIG. 116. *TAENIA DYSBIOTOS*

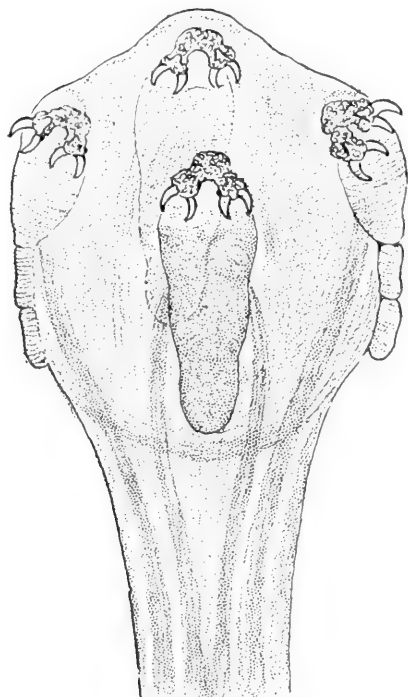
The present worm is about six inches long. It is exceedingly slender from its head to about the middle of the strobila, when it gradually becomes wider, reaching a width of 1.25 mm. The head is rather cubical in shape with a vertical row of suckers on each side which diminish in size from before backward, the anterior one being several times larger than the posterior one. Each side is also surmounted by a cluster of four, large, strong hooks in pairs. These overhang the suckers and must assist materially in retaining the worm's hold. They are therefore the crown as it were, of the head. The head is nearly a millimeter across at its widest part. It is also nearly as deep in its antero-posterior diameter. The hooks are 0.160 mm. in length and 0.080 mm. in width at the base. The largest of the three side suckers is 0.480 mm. in length, the second 0.240 mm., and the third is 0.192 mm. The neck appears to come out almost abruptly from the centre of the posterior surface of the cube, and it there measures 0.80 mm. across, and seems to be a mass of tubes or muscular striae probably both. There are no segments for fully half the length of the worm. A ripe proglottis measures 0.80 mm. in length—1.25 mm. in width. The ovary is large proportionally and is situated at the posterior margin of the segment and from its centre the uterus proceeds anteriorly, nearly to the anterior margin. At about its middle, it receives the vagina, which begins at the cloaca at about the middle of the lateral margin. The cirrus sac is large and pyriform, and is situated posterior to the vagina. The vitellaria are seen along each side of the segment. The cloaca opens irregularly on the lateral margin, sometimes several segments show it on the same side. Then for several consecutive segments it will be seen opening on the other side. The testes are very numerous throughout.

Taenia incognita, sp. nov.

(Fig. 117)

On August 18, 1917, there were found in the spiral valve of a sting ray, *Dasybatus pastinacus*, two small and very unusual taenioid forms.

As will be seen by the plate, the head is irregularly square in form showing four pairs of finely formed hooks with remarkably shaped bases which are golden in color and wrought in a delicate filigree style. Each pair of double hooks overhangs a good sized elongated sucker set longitudinally in the head. To each of these suckers with their hooks is attached a strong pair of muscular bands by which they are functioned. Only two of these worms were found and they are quite small, being only 23 mm. long \times .20 mm. wide. The head measures .75 mm. wide \times .80 mm. long. A slight protuberance presents in front.

FIG. 117. *TAENIA INCOGNITA*

The strobila does not show any segmentation nor do any organs appear. Two tubes of the water vascular system can be plainly traced throughout. They are probably young specimens of an unknown worm.

Taenia trachysauri, sp. nov.

(Fig. 118)

Host—*Trachysaurus rugosus*, Stump-tailed Lizard.

Habitat—Intestines.

Locality—Australia—Zoological Park, New York.

On August 12, 1918, the host of this parasite came for examination. It is a strange looking reptile, being about 13 inches long \times 2½ inches thick. Head triangular, 60 mm. long \times 50 mm. wide; large mouth, full of teeth. Back is black and covered with very rough scales something like a pine cone; belly is black markings on a gray background. Tail only about one inch long, stubby, and thick, much resembling the head. Front legs appear to come out of sides of neck.

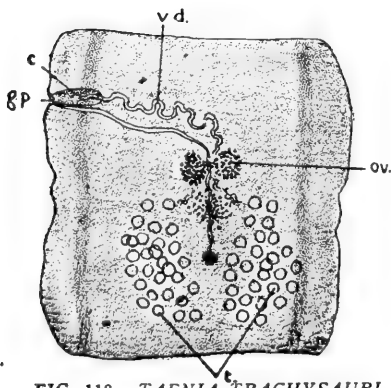
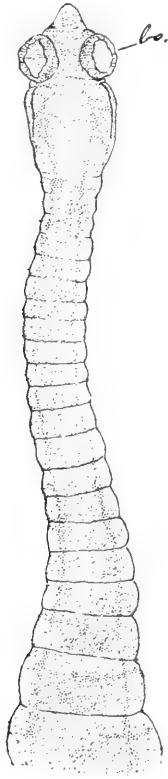


FIG. 118. *TAENIA TRACHYSAURI*

In the intestines there were numerous taenia, which afford the following description: A full sized worm is probably two inches long and quite pointed at the head, indeed, has quite a proboscis which is triangular in shape, and is .20 mm. long and as wide at the base. It is protrusible. Posterior to this portion of the head are four unarmed suckers which are relatively large. They stand out from the head, but cannot be said to be pedicelled. There is, behind the suckers, a neck which in turn is followed by a quadrangular shaped mass, before the strobila shows transverse markings dividing the segments. The genitalia begin to show in the short segments very near the head, and towards the end of the strobila their structure is very distinct, and the segments, which were, at first, very short now become somewhat longer than they are wide. The water vascular system is ample and continuous from the head throughout the strobila. The ovary is situated about the middle of the segment with the vitelline glands posteriorly, and still further toward the base are a number of large testes situated between the lines of the water vascular system. The vas deferens is long and coiling and enters a long oval cirrus sac, as the cirrus which in turn opens into the cloaca. This structure is situated near the anterior margin of the segment, being alternately on one side or the other. The vagina opens also in this cloaca or genital pore.

Measurements of T. trachysauri

Length	about 50.00 mm.
Width	1.00 mm.
Length of proboscis20 mm.
Width of proboscis at base20 mm.
Length of head40 mm.
Diameter of suckers15 mm.

Taenia quadribothria, sp. nov.

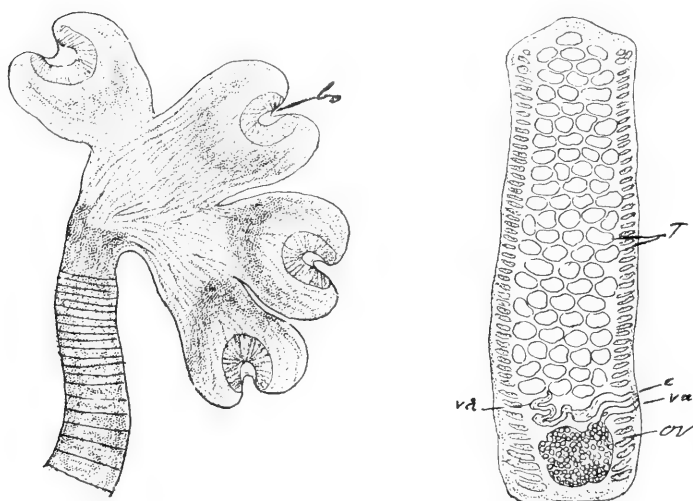
(Fig. 119)

Host—Sting Ray, *Dasybatus pastinacus*.

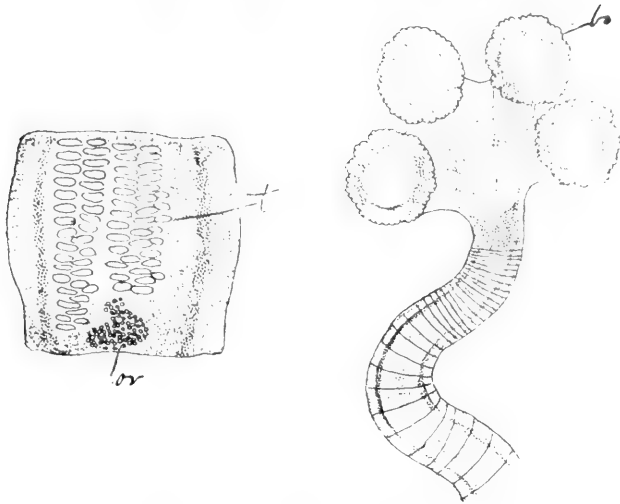
Habitat—Spiral valve.

Locality—Wood's Hole, Massachusetts.

In the spiral valve of a Sting ray, *Dasybatus pastinacus*, there was found at Wood's Hole on July 8, 1916, a very small but remarkable *Taenia*. There were only 12.50 mm. of its length recovered, including the head and loose ripe proglottids. The head measures .1 mm. across

FIG. 119. *TAENIA QUADRIBOTHRIA*

the bothria, of which there are four, and it is these which constitute the peculiar anatomy of the worm. The head presents a fimbriated or digitate appearance, that is it is divided into four pedicelled suckers, which are each from .25 mm. to .30 mm. long and .30 mm. wide across the sucker portion. From the sucker to their attachment is a short neck or pedicel, which is narrower than the outer end, including about the cleft is the sucker proper, which latter does not extend entirely to the extreme margin of the cleft. They give the impression of being relatively powerful. The head formed by the junction of the pedicels terminates in a short neck unstriated for about .25 mm. or .30 mm. Then the strobila is transversely striated as usual in taenia, but not imbricated, and the segments rapidly become longer than at first where they are not more than .2 mm. or .3 mm. in length, at .130 mm. from the head they are .20 mm. long and a ripe segment, which has been thrown off, is .130 mm. long and .45 mm. wide, although they seem to vary much in size. The ovary appears very near the posterior end of the segment with the cirrus and vagina presenting on the left side at the margin slightly in advance of the anterior margin of the ovary, and a vitelline mass can be made out posterior to the ovary. The rest of the body of the proglottis is filled with oblong testes, placed in transverse rows. The vas deferens is a much coiled structure. Outside of the testes and just within the outer skin throughout the whole length on both sides is a mass of what appears to be vitellaria. Nothing is known of the life history of the worm.

FIG. 120. *TAENIA ROSAEFORMIS**Taenia rosaeformis*, sp. nov.

(Fig. 120)

Host—Sting Ray, *Dasybatus pastinacus*.

Habitat—Spiral valve.

Locality—Wood's Hole, Massachusetts.

From that wonderfully fertile region for taenioid parasites, the spiral valve of the sting ray, *Dasybatus pastinacus*, there was found on July 8, 1916, a small *Taenia* which probably has not heretofore been recorded. There were only 5 mm. found including head and strobila. The head is a flat disc composed of four circular bothria and their connective tissue. The two anterior ones being close together and the posterior ones wider apart, in fact they look something like four little roses or daisies. Their margins are corrugated and almost fimbriated, and the surface appears to be quite shallow. They are all connected by muscular striae or bands running in various directions. The head is .13 mm. in diameter and the suckers are each about .4 mm. in diameter. The neck without striations is short, not more than .2 mm. The striations at first are close together, but at the end of the 5 mm. of strobila the segments are .4 mm. long and about .4 mm. wide. The ovary in each segment is placed at the posterior end and the body of the segment is filled with two transverse rows of oblong testes, and outside of these along the sides is what appears to be a thick layer of vitellaria. The genital pore is unilateral, opening near the posterior end on the right side. The excretory canals run throughout from the head on both sides near the skin. The segments are not imbricated. No life history is known.

Duthiersia elegans, Perr. 1873b.

(Fig. 121)

Family—*Bothriocephalidae*, Cobb.

Subfamily—*Dibothriocephalinae*, Lühe.

Genus—*Duthiersia*, Perroncito 1873b.

Host—*Varanus salvator*.

Habitat—Stomach and intestines.

Locality—Buitenzorg, Java.

On May 27, 1916, Dr. W. G. MacCallum found in a monitor a number of these worms which should be recorded if only to note the distribution and host. The first was found by Perroncito in *V. niloticus* in Senegal and named by him *D. elegans*; since that time it has been found and described by several authors, and two other species named as *D. expansa* and *D. fimbriata*. However, now I believe it has been agreed that *D. fimbriata* should be the name and the others only synonyms.

It seems to be settled also that it is a form closely allied to *Solenophorus*. It has a more ornate head than any other member of the family. On close inspection the head will be found to be composed of two distinct suckers, the anterior edges of which are much fimbriated on their margins by numerous gracefully formed small suckers, and subsidiary to the two main suckers. There does not seem to be at the base of the main suckers any accessory sucker or opening such as is seen in some forms of *Solenophorus*, and here perhaps I may be allowed to express my opinion that the so-called accessory suckers at the base of the head in the above forms, are not "merely blind sacs," but are openings connected with the main suckers and functioned by the worm to enable it to release its hold of the firm attachment to the mucous membrane. In *D. fimbriata* the numerous small suckers on the margins of the main suckers can be partially relaxed and thus allow relaxation of the whole.

These worms exist in the stomach and intestines in various sizes and as they are easily broken, the strobila is generally found in pieces. The longest pieces found in two or three specimens of varanus were about 12 cm. \times 5 mm. and 15 cm. \times 5 mm. and 1.50 mm. thick. One about 10 cm. \times 2 mm. wide was whole but young. Another whole one was 20 cm. \times 3 mm. wide with ruffled posterior segments. The neck of the worm is free of segment marking for a short distance, and is gracefully narrow. This, however, is followed by a strobila which rapidly increases in width.

It is unnecessary to describe the genitalia, etc. for it is that of the *Bothriocephalidae*. However, a figure of a ripe proglottid is herein shown.

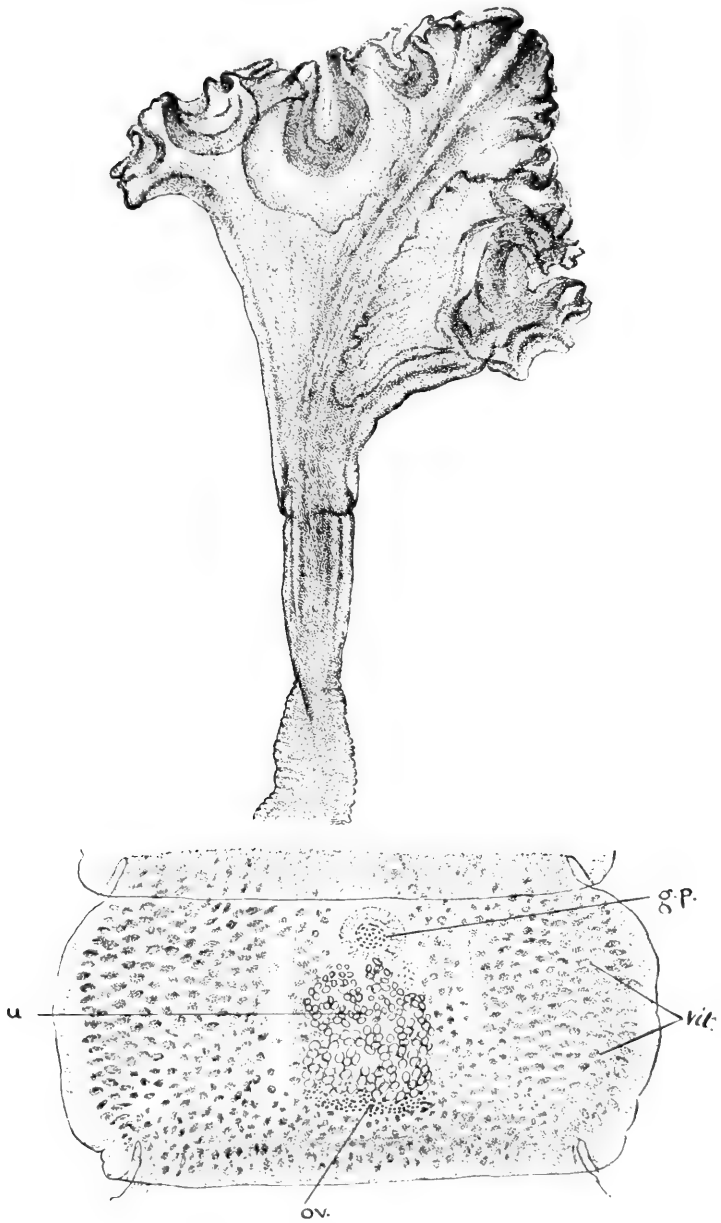


FIG. 121. *DUTHIERSIA ELEGANS*

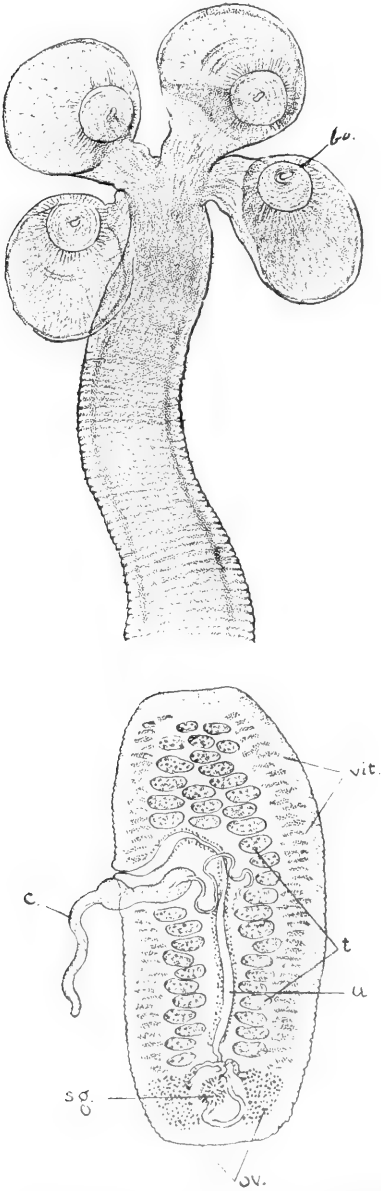


FIG. 122. MONORYGMA GALEOCERDONIS

Measurements of D. elegans.

Length	20.00 mm.
Width	3×5 mm.
Thick	1.50 mm.
Head, varies in size.	

Monorygma galeocerdonis, sp. nov.

(Fig. 122)

Host—*Galeocерdo tigrinus*.

Habitat—Spiral valve.

Locality—Wood's Hole, Massachusetts.

This worm was found on August 14, 1915, in the spiral valve of a tiger shark, *Galeocерdo tigrinus*, and a number collected.

Diesing in 1863 first called attention to this form naming it *M. perfectum*, although Beneden claims to have found it in 1853 in *Laemargus borealis* at Ostende, and since it has been found in several other fish. There seem to be several species, at least five or six. Linton found one in a *Galeocерdo tigrinus* at Wood's Hole and also the same form in a *Carcharinus* at Gay Head, but he did not name the species. Consequently this one under consideration may be the same form, but of this I have no knowledge, and in order to give it a place I have given the species the above name. The one described shortly by Linton seems to have been a much smaller form, measuring in length only 3.77 mm., length of head 0.035 mm., diameter of neck 0.15 mm., and distance to first segment 1.6 mm., and ripe segment 0.65 mm. long \times 0.17 mm. wide, a much smaller worm than this.

I have never seen any other species, but this is a remarkable form. Its head is represented by apparently four large suckers on long foot stalks and at the base of each of these is a smaller, very muscular sucker placed within the larger one. This is very peculiar, and yet the expansion at the end of each pedicel presents the appearance and structure of a sucker being deeply concave with a rim around its margin and muscular fibres, running towards the centre or rather towards the smaller sucker. Beside these there appears to be a certain amount of granular matter in the outer and larger portion of each sucker. These suckers on their stem flare out in different directions resembling a flower. They measure 0.360 mm. across and the small sucker measures 0.160 mm. across. The pedicel measures across near the head 0.120 mm. The neck is free of striations for the first 0.80 mm., although the margins are delicately notched, and the water vascular system is plainly shown. The striations, as usual, are at first very close together, but they gradually widen as the segments grow longer until the end where are the ripe segments, which measure in length from 0.80 mm. to 1.04 mm., and from 0.40 mm. to 0.48 mm. in width. The ripe segment is

a beautiful structure which stains unusually well, showing all of the organs plainly. The cirrus is usually exerted and is 0.40 mm. long with a circular bulb outside of the cloaca 0.080 mm. in diameter. As will be observed, Linton's worm is much smaller in every way, and thus could not be the same species. The length of *M. galeocerdonis* is 10 mm. \times 0.480 mm. wide. Diameter of head 0.960 mm. The skin throughout is thick and delicately striated.

Taenia acanthobothria, sp. nov.

(Fig. 123)

Family—*Davaineidae*, Fuhrmann, 1907.

Host—*Aetobatis narinari*.

Habitat—Spiral valve.

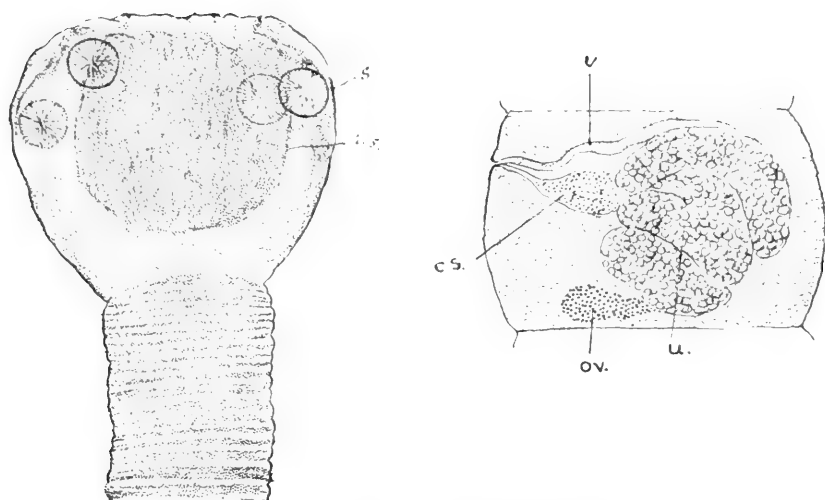
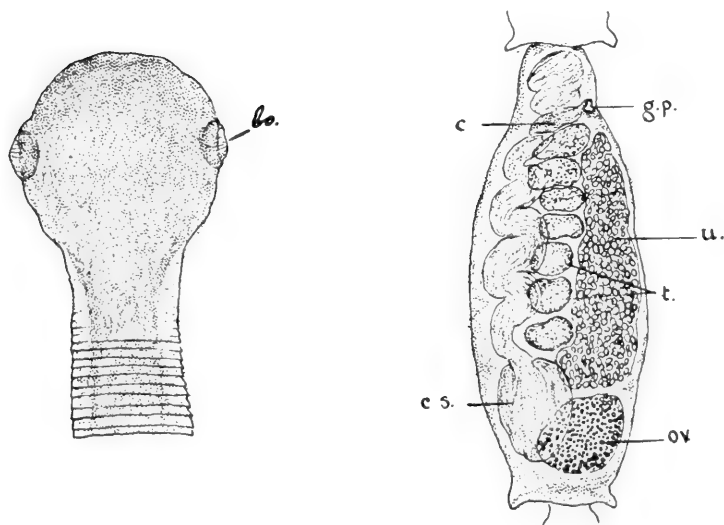
Locality—Batavia, Java.

These worms, of which there were several, were found in the spiral valve of an *Aetobatis narinari* at Batavia, Java, on August 25, 1916, by Dr. W. G. MacCallum.

The head is cup-shaped and through the almost transparent tissue of the head may be seen a large rostellum which is evidently protrusible. Its margin can barely be seen to have any armature, although small marginal hooks can be easily seen even in specimens in which the rostellum is not protruded. The four suckers are each surrounded by a single row of small spines. The suckers are not relatively large and they are located near the anterior margin of the head. The neck is comparatively thick and striated very near the head. These striations gradually enlarge as the proglottids develop. The ripe proglottis is considerably wider than long and is rounded on its lateral margins. The genital pore appears on either side, near the anterior corner of the segment in the shape of a notch at which both cirrus and vagina are present. The cirrus sac is a fusiform sac. The uterus is filled with eggs and appears in the form of long sacs. The ovary is at the posterior margin and few or no testes are seen in these ripe proglottids.

Measurements of Taenia acanthobothria.

Length	20.00 mm.
Width60 mm.
Suckers096 mm.
Across head896 mm.
Across neck280 mm. to .400 mm.
Rostellum560 mm.
Depth of head.....	.560 mm.
Width of proglottis.....	.320 mm.
Eggs, round and yellow.....	.016 mm.

FIG. 123. *TAENIA ACANTHOBOTHRIA*FIG. 124. *ANOPLOCEPHALA GLOBOCEPHALA*

Anoplocephala globocephala, sp. nov.

(Fig. 124)

Host—A small ray.

Habitat—Spiral valve.

Locality—Singapore.

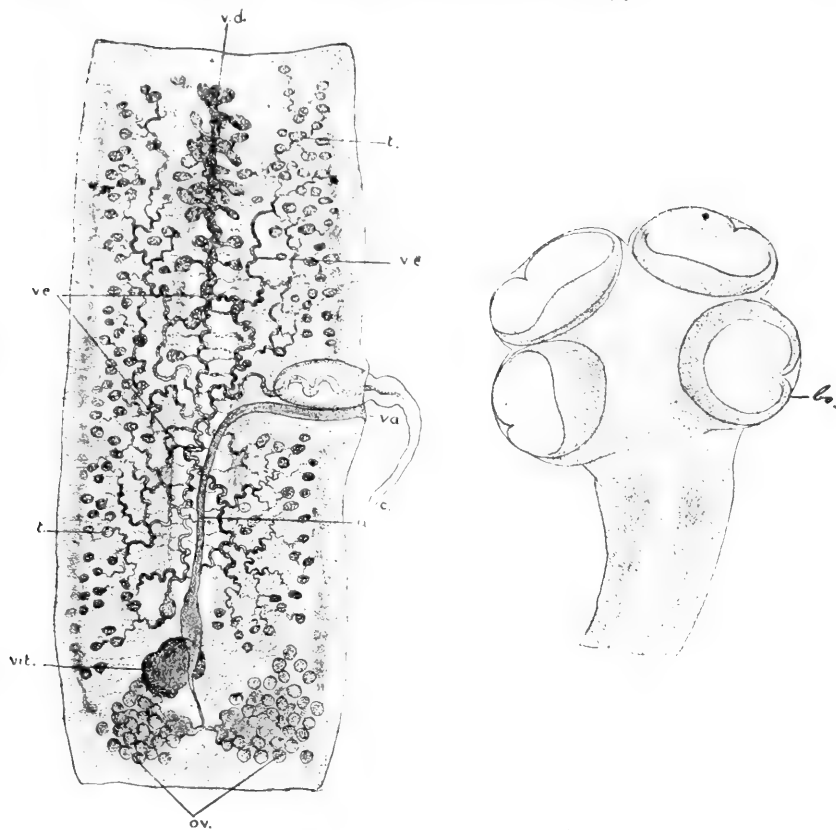
This small tapeworm was found in the spiral valve of a small ray, species not identified, at Singapore. On account of the almost globular head, it has been given the above name. When found, the head was buried in the mucous membrane of the intestine and was with difficulty withdrawn, and many others were broken in the attempt. It is very small, but presents many interesting characters. As will be observed (Fig.,) only two bothria are visible, but undoubtedly there must be two others on the opposite side. These bothria stand out prominently past the surface of the head. There is an opening at the extreme anterior margin of the head filled with a myzorhynchus, which is probably protrusible. The neck is about half the width of the head and presents transverse striae almost up to the head. The segments soon become longer and are decidedly imbricated. The ripe segments are peculiar, inasmuch as the ovary is situated at the extreme posterior end lying beside a large cirrus sac, which at once narrows into a coiling vas deferens which proceeds to a genital pore near the anterior end of the segment, where the anterior end of the segment is quite pointed, the posterior end being imbricated. Six or seven relatively large testes fill up the middle of the segment, and the rest of the space is filled with a uterine sac of eggs. The ripe proglottids appear like a string of fusiform shaped beads.

Measurements of A. globocephala.

Length	25.00	mm.
Width35	mm.
Head45	mm.
Length of ripe proglottis.....	1.00	mm.
Width of ripe proglottis.....	.40	mm.
Eggs016	mm.
Ovary20	mm.
Testes10	mm.

Family—*Tetrabothridae*, Fuhrmann, 1908.Subfamily—*Tetrabothrinae*, Fuhrmann, 1907.Genus—*Tetrabothrius*, Rudolphi, 1819a.

This genus was formerly described as only inhabiting mammals and birds in the adult form, but of late years it has also been found to be recorded for reptiles, and the following is a case in point. The diagnosis—It is a taenoid with the scolex unarmed. There are four suckers, each of which is incomplete on its outer margin, where there

FIG. 125. *TETRABOTHRIUS BOAE*

is a triangular notch. There is no rostellum, neck is well developed but no markings of segments are seen for a considerable distance, six or eight mm., then the proglottids outlined are very short but becoming much longer towards the end of the strobila. The bothria are large, prominent and cupshaped, almost as if set on pedicels. They are joined together by muscular striae at their bases. The whole head is unarmed.

Tetrabothrius boae, sp. nov.

(Fig. 125)

Host—Boa constrictor.

Habitat—Stomach and intestines.

Locality—Brazil; Zoological Park, New York.

In the stomach and upper part of the intestines there were found in the *Boa constrictor* from Brazil a large number of these worms.

Some of them were as much as twenty feet or more long. The opening of the uterus is in the anterior middle of the ripe segments. The ovary is large and the vitelline gland is situated in front of the ovary which is unusual. In this case, too, there seems to be on each side of the proglottid a row of vitellaria, but the main mass is in front of the ovary. A wide split or opening extends from the front of the ovary to the anterior end of the segment and in this the uterus and vas deferens make their way towards the genital cloaca. The rest of this middle opening is occupied with vasa deferentia which are in connection with the numerous large testes on either side. These all concentrate in the large vas deferens which enters the cirrus pouch or sac near the genital pore. This sac is oval and the cirrus may be seen through its transparent walls. The cirrus is a relatively large organ and is frequently seen protruded. It is quite enlarged near its base. Posterior to this and beginning at the cloaca is the vagina which is situated posterior to the cirrus sac. The genital pore is irregular and alternately unilateral. The vitelline gland in front of the ovary is circular and measures .400 mm. in diameter. Baird described a worm of this species from this host under the name of *T. gerradu* in 1860. This may be the same worm, but am not certain. See segment, Fig. 125.

Measurements of T. boae

Length	20 to 30 feet
Width	2.60 mm.
Width of head	2.00 mm.
Length of head....	1.50 mm.
Diameter of bothria	.80 mm.
Ovary	1.040 mm.
Cirrus96 mm.
Ripe segment	4.40 mm. long \times 1.60 mm. wide

Dibothriorhynchus maccallumi, sp. nov.

(Fig. 126)

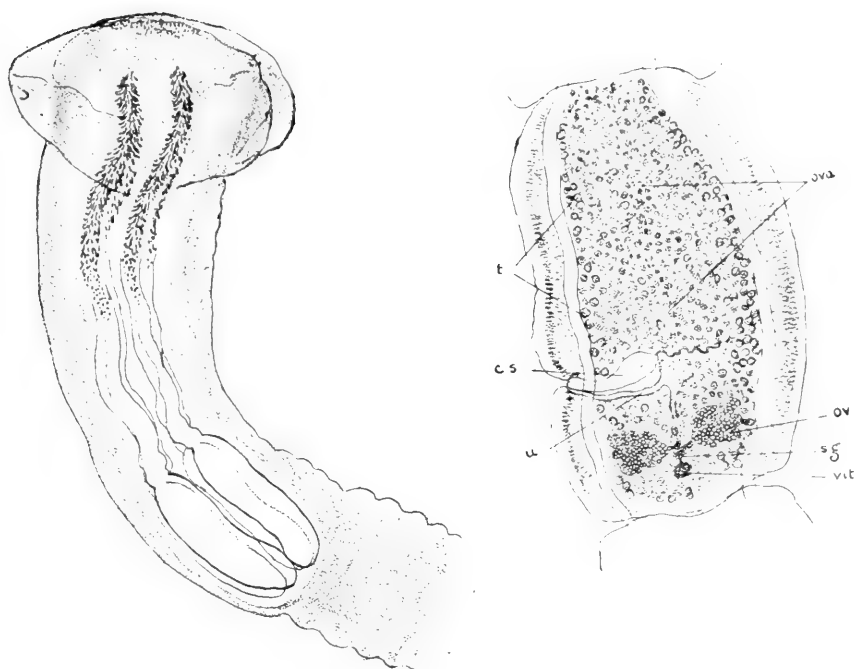
Host—*Sphryna tiburo*.

Habitat—Spiral valve.

Locality—Off Port Darwin, Australia.

On April 30, 1916, Dr. W. G. MacCallum, during an autopsy on a bonnet-head shark, found numbers of these worms in the spiral valve. There were also large numbers of ripe segments or proglottids in this location, which were quite large, being 7 mm. long \times 2.40 mm. wide.

Linton, in his work at Beaufort, North Carolina, described a somewhat similar worm from this host, but apparently not the same. This mature worm had a head with two bothria, very delicately formed, with the anterior edges of the bothria carrying many small spines, and be-

FIG. 126. *DIBOTHRIORHYNCHUS MACCALLUMI*

side these on the lateral margins there was a much larger single hook, also on the lateral margin of each bothrium. In the figure given, the proboscidae are not shown protruded, but they can be plainly seen through the semitransparent tissue. The neck is thick and the muscular bulbs are short, as also are the containing tubes, which show the armed proboscidae as being short and thick. The tube measures .240 mm. near the outlet. The spines are large and recurve toward the apex as they lay in the tube to be reversed on extension.

The whole head is much wider than it is deep, and is joined by an unusually thick neck. The strobila shows striations immediately back of the bulbs, but they are not so deep as in that of some other of these forms. They are at first about 1.36 mm. wide and .192 mm. long. At about the middle of the segments are 1.44 mm. \times 1.10 mm. long. The divisions here, too, are more deeply marked, but still the strobila is not imbricated. The segments are rather square with the genital organs near the posterior end. The ovary is divided into two parts with the shell gland behind and between the two halves. The genital pore appears on the left side one-third from the posterior end, and there the somewhat triangular shaped armed cirrus presents. The

body of the segment is filled with testes and ova. The vitellaria are on both sides of the segment near the margin and a wide water vascular canal is also on each side.

Measurements of D. maccallumi.

Length of mature worm.....	3 inches
Width of mature worm.....	1.00 mm.
Across head	1.70 mm.
Depth of head.....	1.00 mm.
Width of ripe segment.....	1.10 mm.
Length of ripe segment.....	1.20 mm.

Tetrabothrius lachesidis—sp. nov.

(Fig. 127)

Host—Fer de Lance, *Lachesis lanceolatus*.

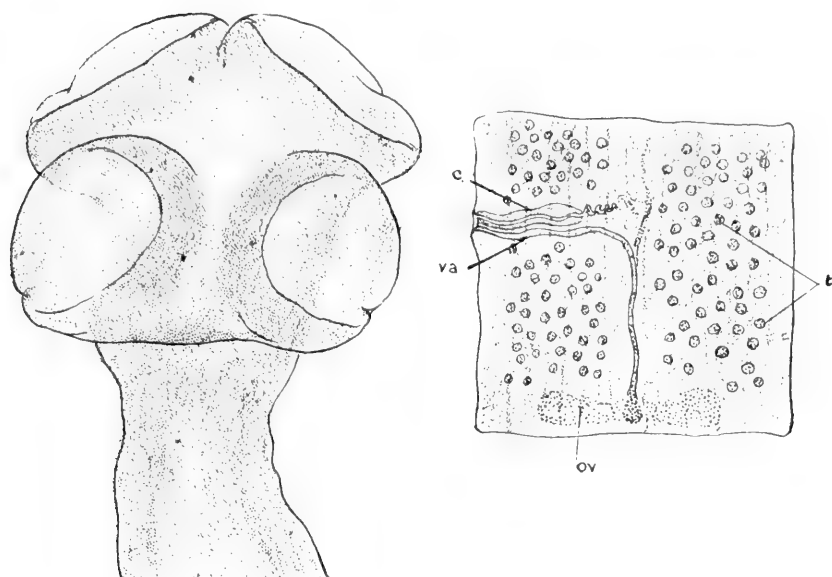
Habitat—Intestines.

Locality—Island of Trinidad, South America.

The type specimen of this worm was found in a *Boa constrictor*, Brazil, March 12, 1919, a large snake seven feet, six inches long.

This form was taken from the intestine of its host and it corresponds with the type, although much smaller. The head has four deep suckers which are unarmed, no rostellum. The suckers have each a notch on one side, and the substance of the head is seen to be striated with muscular fibres in all directions. The head is unarmed. The neck is free of striations for the first 1.120 mm. The strobila recovered was not more than about 75 mm. in length, and no ripe proglottids were seen. These, when seen, are open longitudinally to contain the gravid uterus, hence Rudolphi described it as a subgenus of *Bothriocephalus*.

The ovary is relatively large and the uterus extends from the ovary almost to the anterior end of the proglottis. The genital pore is situated irregularly alternately about the middle of the lateral margin of the segment, and the vagina curves toward the centre to join the uterus. The testes are numerous and large, and the cirrus sac containing the cirrus is large and opens anteriorly to the vagina in a common cloaca. There does not appear any vitelline gland anterior to the ovary in this instance, but only a portion of the strobila is seen—no ripe proglottids. In the proglottids of *T. boae* in *Boa imperator*, another host, the vagina is seen to be anterior to the cirrus in the cloaca. Otherwise the worms are like that above described. In ripe segment the ovary is at the posterior margin, uterus starting at the shell gland in the middle and proceeds to the right side of segment near the anterior quarter, cirrus anterior to the uterus. Rest of square segment filled with testes and vitellaria.

FIG. 127. *TETRABOTHRIUS LACHESIDIS**Measurements of T. lachesidis*

Length	unknown
Width	1.20 mm.
Diameter of head.....	.960 mm.
Diameter of bothria.....	.560 mm.
Width of ovary.....	.720 mm.
Length of proglottids	1.44 mm.
Width of proglottids.....	1.120 mm.

Tetrabothrius brevis, sp. nov.

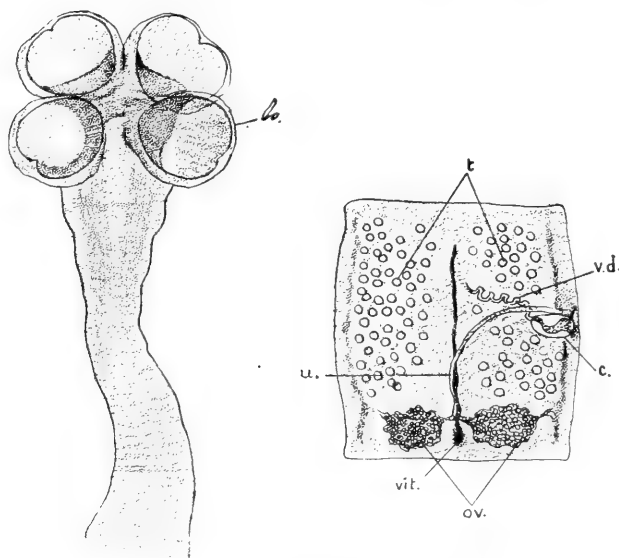
(Fig. 128)

Host—*Boa imperator*.

Habitat—Stomach and intestines.

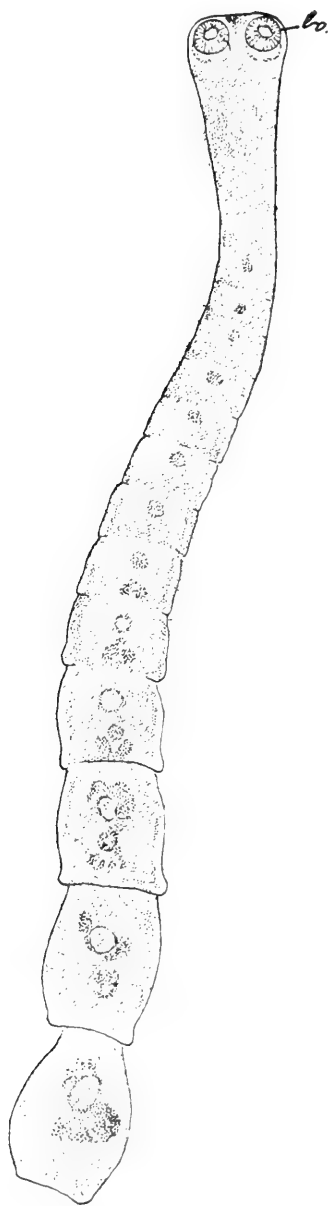
Locality—Mexico.

During the examination of this snake which was 60 inches long and $2\frac{1}{2}$ inches in diameter, a lot of worms were found in the first part of the intestine, and one large one was found alone in the stomach. They were quite lively and coiled and tangled themselves very much. These are about 10 to 15 inches long, possibly longer, for some of those with the widest strobila were evidently broken, in fact few could

FIG. 128. *TETRABOTHRIUS BREVIS*

be found which one could be sure were entire. As will be seen, they are quite a different species from those found in *B. constrictor* from South America. The anatomy of the ripe proglottids is quite different as will be seen by a comparison of them. They are both *Tetrabothridae*, but of different species, which may be found throughout Mexico and Central America. These worms found have a head almost exactly similar to that of *T. boae*, the same raised cup-shaped suckers with the usual triangular notch in the external margin. They are quite unarmed, but from their muscular structure and that of the head proper, they give the impression of great power. The neck rapidly narrows from the head and shows ample water vascular tubes. The transverse markings on the strobila are, at first, very close together, but towards the posterior end of the strobila, the ripe proglottids are even longer than wide. Their structure showing the genital apparatus is as follows. Near the posterior end, the two large lobes of the ovary are distinctly seen joined together, and from the centre of this junction arises the uterus which extends almost to the anterior end although receiving the vagina about its middle. The vagina curves to one or other lateral margin at about its middle, but crossing the vas deferens, opens in front of the cirrus at the cloaca. The cirrus, after passing through an oval shaped cirrus sac near the cloaca, appears behind the vagina, and its outlet is surrounded by a mass of short hair like structures.

On each side of the uterus the segment is filled with testes and some eggs. The vas deferens is a much coiled structure, connected with the testes and terminating in the cirrus sac, but the whole anatomy

FIG. 129. *MESOCESTOIDES BASSARISCI*

of the ripe segment is entirely different from that of *T. boae*, as may be seen by a reference to the plate of that worm. Neither worm has any rostellum. The developed segment is somewhat longer than wide.

Measurements of T. brevis.

Length	about to 15 inches
Width of widest segments..	2.00 mm.
Width of head.....	2.00 mm.
Width of sack sucker.....	.80 mm.

Mesocestoides bassarisci, sp. nov.

(Fig. 129)

Family—*Mesocestoididae*, Fuhrmann, 1907.

Subfamily—*Mesocestoidinae*, Lühe, 1894a.

Host—*Bassaricus astuta*, Rhoads, 1894.

Habitat—Intestines.

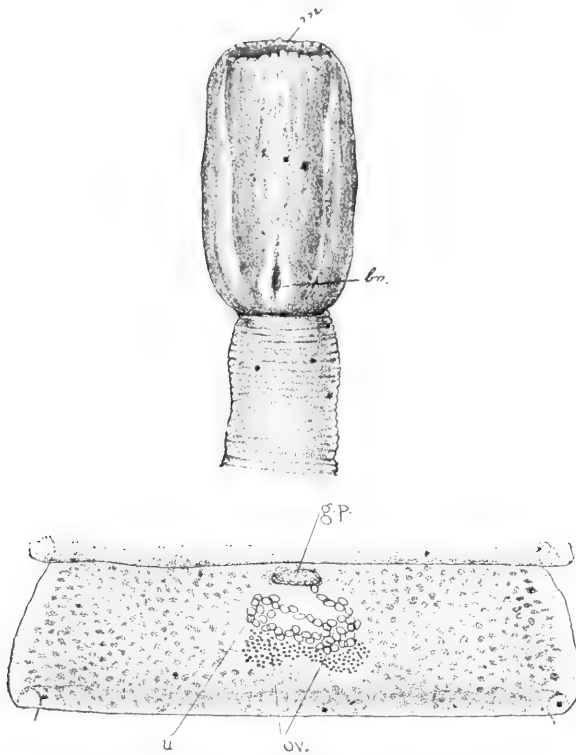
Locality—Zoological Park, from Mexico.

These worms were found on April 1, 1919, in the first part of the small intestine, posterior to the stomach. There were great numbers of them. They are very small and present some peculiarities in their morphology. Although much smaller than the type species, *Mesocestoides ambiguus*, Vaillant, 1863, yet in most other characters it would seem to belong to this family.

The head and neck present a triangular form. The head itself has no rostellum, in fact distally between the suckers it is flat or depressed. It is entirely unarmed as are also the suckers which are circular. The suckers are relatively large. The neck is smooth and devoid of striations for about one-quarter of the length of the worm. The segments then begin to be formed and from the first there is seen in each a dark spot showing the location of the genitalia. The ripe segments are not sharply marked off from each other, the lateral outline of the strobila only showing a slight depression between each pair. The genital pore is median and situated well towards the anterior margin of the proglottis, and the uterine tube extends back between the two lateral masses of the ovary and behind those is to be seen the vitellaria. The testes are comparatively large and not numerous. All the genitalia are included between the longitudinal excretory canals. The host is a small coyote with a ringed black and white bushy tail. It is found in Mexico and southern North America.

Measurements of M. bassarisci.

Length	4.00 mm.
Width70 mm.
Across head320 mm.
Suckers120 mm.
Eggs040 mm. \times .024 mm.

FIG. 130. *SCYPHOCEPHALUS BISULCATUS*

Scyphocephalus bisulcatus, Riggenbach, 1898b. *
(Fig. 130)

Family—*Bothriocephalidae*, Cobbold.

Subfamily—*Scyphocephalinae*, Ariola, 1899d.

Host—*Varanus salvator*.

Habitat—Intestine.

Locality—Buitenzorg, Java.

On May 27, 1916, Dr. W. G. MacCallum, while autopsying a monitor, came across two of these worms in the reptile's intestine. One was loose while the other had a firm hold on the wall of the intestine. It was so firmly attached that a piece of the intestine had to be cut about the mouth, and even then it was impossible to separate the sucker from its hold without tearing it. In many ways this worm seems closely related to *Duthiersia* and *Solenophorus*. It is found in the same host, in the same habitat, their only chief difference being the

*Vorläufige, Mittheilunge, Zool. An. 2, Leipz. 2. (572) V. 21, Vol. 7, pp. 465-566.

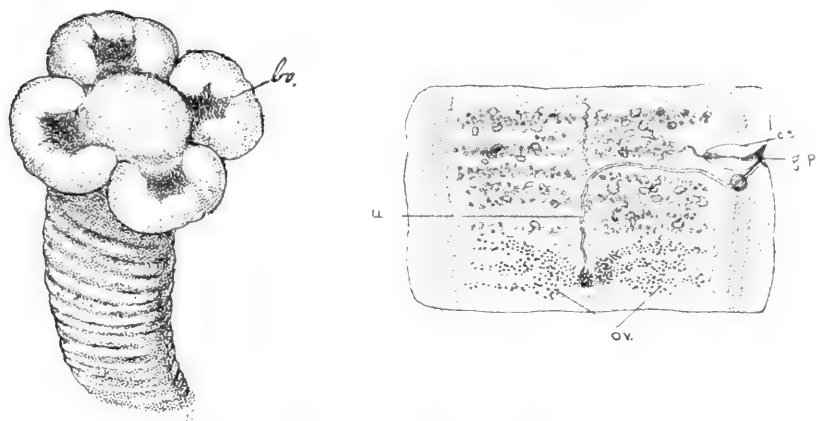
anatomy of the head, for the strobila is similar. The head is different, for instead of consisting of two pipe-shaped suckers as in the *Solenophorus* and the very ornate head of the *Duthiersia*, which also is divided into two main suckers more or less triangular in shape, this worm has only one single goblet shaped sucker which is exceedingly muscular and powerful. It has also two sulci somewhat like those of the other members of the family. These are situated on opposite sides of the base of the head and are comparatively short. They are deep at the posterior end, but become shallow as they extend anteriorly. Thus, it will be seen, that the worm really belongs to the order *Tribothria*. Ariola 1899 and Lücke 1899 p. 542, and Braun 1900 a p. 1676, 1682. The head is whiter in color than the rest of the worm, and the whole anterior end is an open sucker mouth and its margin is divided into closely set teeth-like processes or coarse serrations apparently only of the mucous membrane. The walls of the head are thick and striated or thrown into very narrow folds, which may only be muscular striations. The cavity of the sucker occupies almost the whole head and terminates just posterior to a slit-like opening which looks like a long genital pore, which however, is the sulcus appearing on either side. In *Scyphocephalus*, the strobila does not begin with the neck, but the striations are to be seen at once after the head. It soon widens, but does not become very wide. It is thick and the segments are narrow even when ripe. The ovary is quite distinct and the uterus has only a few coils from which the yellow oval eggs are given off at the more or less circular pore near the middle of the anterior margin of the segment as is usual in the *Bothriocephalidae*. The viter-laria are plentiful but the testes are not abundant.

Measurements of S. bisulcatus

Length—This cannot be given as only three or four pieces were found, less than six inches in all.

Width	4.00 mm. and 1.00 mm. thick
Head, length	3.40 mm.
Head, width	2.40 mm.—6.00 mm.
Length of sulci.....	2.20 mm.
Width of each sulcus.....	1.00 mm.
Length of ripe proglottids..	.80 mm.—1.00 mm.
Width of ripe proglottids..	6.00 mm.

Riggenbach, who first described this worm, claims that it is a new genus and new species, for while it has the strobila of the *Bothriocephalidae*, it cannot on account of the character of its head be classed in that family, whose chief characteristic is the fact that the head has only two sulci or bothria, while *Scyphocephalus* has three bothria, a central main bothria and two lateral ones. He is of the opinion that the central main sucker must have been formed secondarily and that the lateral sulci or suckers are in a state of partial retrogression

FIG. 131. *TAENIA PATINI*

and that from lack of use may disappear finally. In every other respect than in the matter of suckers the worm follows the morphology of the *Bothriocephalidae*. I have, therefore, tentatively at least, left it in the family *Bothriocephalidae*.

Taenia patini, sp. nov.

(Fig. 131)

Host—Ikan patin.

Habitat—Intestine.

Locality—Bandjermassin, Borneo.

This interesting cestode was collected at Bandjermassin, Borneo, by Dr. W. G. MacCallum from a large siluroid fish, locally known by the name Ikan patin. The host was taken in the river at that point and appeared to be of the catfish family, and was decorated with four fairly long barbels. The only parasites found were a number of the above taenia and some strongyles, all found in the intestine. It is claimed as a new genus on account of the peculiar structure of the head.

The *Taenia* is a worm about twenty inches in length, and is but little narrower at the neck than at the widest portion of the strobila, and it is thick and fleshy. The head is of peculiar formation. It enlarges suddenly from the neck and is fluted into four main masses and these again are superficially divided by lines which run to the anterior margin. The extreme anterior aspect is somewhat hollowed out and divided into four bothria with large thick marginal lips which are somewhat puckered about their central opening. In the centre is a round, prominent myzorhynchus, which may be protrusible, but which in quietude is below the level of the marginal lips of the bothriae, and

seems to be of a different structure and color from the rest of the head, being yellow and dense. On looking at the head as pressed and mounted on a slide, it appears to be a double row of finger-like processes, longest on the outer margins, all pointing anteriorly and relatively deep among them are the four bothriæ. The neck is thick and is crossed from side to side by irregular transverse divisions. These divisions or segments are narrow throughout the strobila with irregular margins, but as the segments get more fully developed the margins are not so irregular and the genital cloaca is seen to be near the junction of the anterior one-quarter with the posterior three-quarters. This is seen alternately on one side or the other. The cirrus sac is a long oval, and the cirrus presents anterior to the vagina at the cloaca. From the posterior end of the same is seen the much coiled vas deferens coming from different parts of the segment after communicating with the testes. The vagina has a funnel shaped inlet, and at a short distance from its entrance may be seen a more or less rounded muscular constrictor. This is very conspicuous and quite unusual. It is more than twice the diameter of the vagina.

The ovary is very near the middle of the posterior margin, and while it is composed of two masses, it is divided by a narrow portion, where apparently the uterus begins, and this, after coiling through the shell gland situated near the posterior margin of the segment, makes its way anteriorly through the centre of the segment, receiving the vagina shortly after its origin. The testes are large and numerous. Vitellaria, marginal.

Measurements of Taenia patini.

Length	20 inches
Width	3.00 to 4.00 mm.
Width of neck.....	1.50 mm.
Width of head.....	2.00 mm.
Width of ripe proglottids	3.00 mm.
Eggs120 mm \times .040 mm.

Rhynchobothrius carangis, sp. nov.

(Fig. 132)

Host—*Caranx hippos*.

Habitat—Cyst in intestine.

Locality—New York Aquarium, Eastern Coast, U. S.

This worm was found in a cyst on the rectum of a *Caranx hippos*, common crevalle. On account of its rarity and unusual bothriæ it is thought necessary to put it on record. It has only two bothriæ which are placed flatly face to face, and resemble very much two flowers, and between these the proboscidae make their exit. The worm is 11.50 mm. long by 1 mm. wide. The proboscidae are protruded about 1.40 mm., and the bothria are 1.40 mm. wide. It is of course a cestode larva and

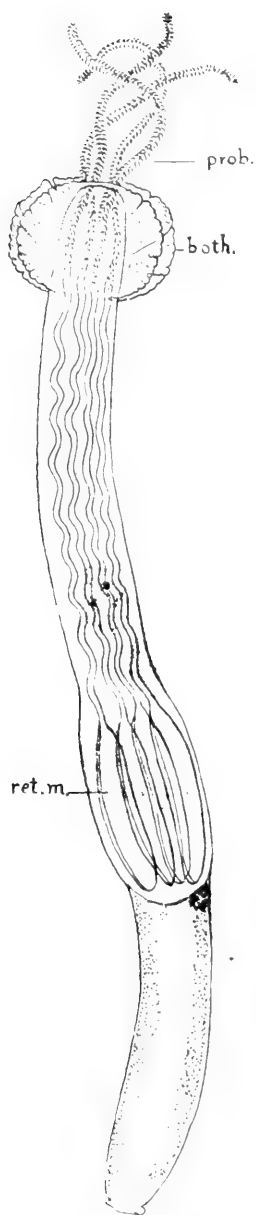


FIG. 132.
RHYNCHOBOTHRIUS CARANGIS

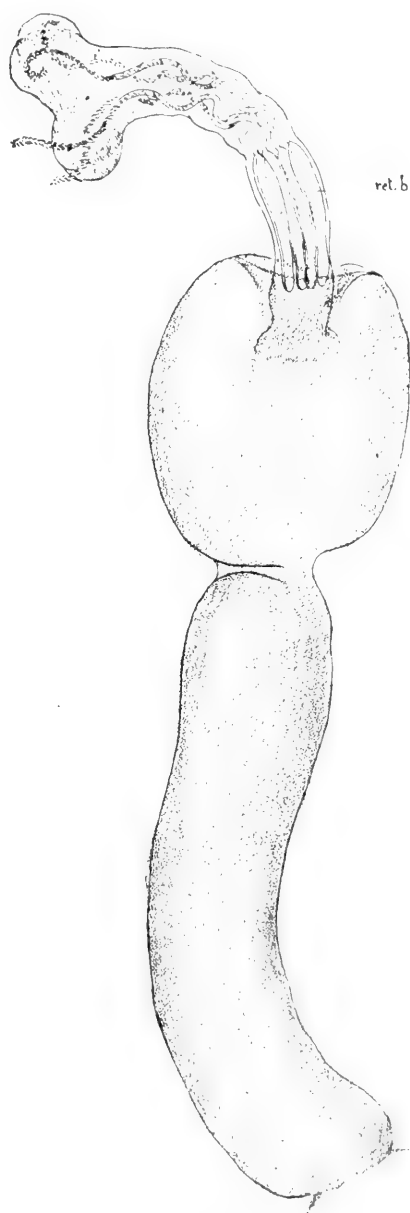


FIG. 133.
RHYNCHOBOTHRIUS TANGOLI

was not found in its final host where it could be developed into an adult. The host came from the New York Aquarium, March 17, 1914.

Rhynchobothrius tangoli, sp. nov.

(Fig. 133)

Host—*Ikan tangol*.

Habitat—Peritoneum.

Locality—Bandjermassin, Borneo.

On July 1, 1916, this worm or larva was found by Dr. W. G. MacCallum, while dissecting a fish called by the natives *Ikan tangol*. It belongs to the mackerel family and is much thought of as a food fish. The worm is peculiar in its structure. The head, or anterior end, is a more or less rounded sac enclosing the clinging apparatus which may be protruded entirely from the sac through a sharply defined circular opening. It consists of a head portion which is divided into four bothria, separated by a central tube through which four proboscidae proceed anteriorly after crossing each other diagonally several times, until they reach the bothria where they separate one to each bothrium. Posteriorly, as in common with these worms or larvae, they are attached each to an elongated muscular bulb which has the power to force the proboscidae externally or to withdraw them at will. These proboscidae, as in this case, are armed throughout their whole length with powerful hooks arranged in lines. They can be plunged into any tissue and, what is strange, can be withdrawn quite as easily. This is a peculiarity of this class of worms of which there are many species, and the arrangement is perfect in holding the worm in position while its structure absorbs its nourishment from the fluids of its host. They do not live on the blood of the host for they have no sucking apparatus. They live rather like the *Taenia*, which they resemble in some particulars, especially the way in which they are reproduced. In the adult form, they have a body which develops segments, each one containing all of the genital apparatus for reproducing its kind and which when ripe are cast off to be taken in by its host, some fish or other aquatic form. In this case, beside the head and sac there is a prolonged body which shows striations, but they are not very regular divisions, nor do they contain visible rudiments of genital organs. The whole worm measures from an inch to an inch and a half in length, and the head sac is distinctly separated from the body by a decided neck or constriction.

Measurements of R. tangoli.

Length	25.00 mm. — 35.00 mm.
Width	2.00 mm.
Head	3.00 × 2.5 mm.
Proboscidae and muscular bulbs	
about	4.00 mm.
Across bothria	1.00 mm.

NEMATODES

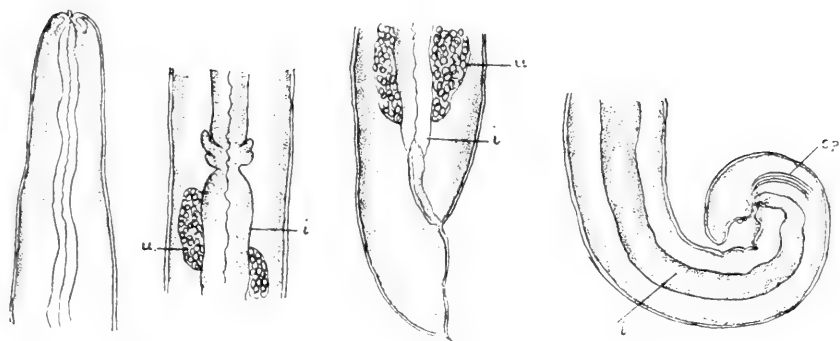


FIG. 134. *ASCARIS CEBI*

Ascaris cebi, sp. nov.

(Fig. 134)

Host—*Cebus capucinus*.

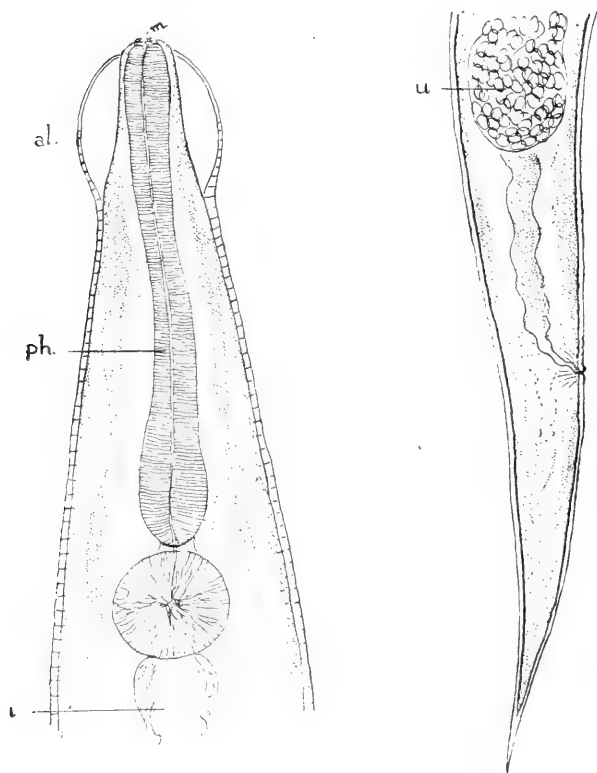
Habitat—Stomach and oesophagus.

Locality—Africa; Zoological Park, New York.

This little monkey, *Cebus capucinus*, was obtained from the New York Zoological Park, and was much emaciated and, as usual with animals or fishes or even plants when much below par, they become infested with other organisms than those which produced their anaemia and emaciation. In other words, in lowered condition, the animal offers a much lessened resistance to parasites. In the case of fishes, one seldom sees in nature a sick fish simply because, when ill they are more sluggish and less able to take care of themselves, consequently fall an easy prey to those larger fish which live upon them. Yet many fish suffer from ectoparasites or external enemies as Microcotyle on the gills, etc., which in numbers so exhaust the blood supply of the host as to cause death. This rule also holds good with reference to mammals, birds, etc., and it is almost the rule that one of these being out of health is a favorite breeding ground for lice and other parasites on the skin. A plant in lowered condition is almost sure to become infested with aphides and other parasites.

So this monkey with many different intestinal parasites beside the inordinate infestation of ascarids, became very thin and harbored great numbers of lice on its skin.

The ascarids, however, were the immediate cause of its death, for beside about a hundred tangled in a ball in its stomach, the

FIG. 135. *OXYURIS SIMLAE*

oesophagus was found stuffed with these and even some were found in the larynx. One was found actually coiled about the epiglottis so that the respiration was interfered with, and in patches the lungs were found collapsed and in some areas emphysematous.

The *Ascaris* was named *A. cebi* and this is perhaps only another synonym for *A. elongata*, Cobb. The female worms were stiff and much coiled and about 45 mm. long, and the males much slighter in form and 30 mm. in length.

The genital pore is about one-third the length of the worm from the tail. The eggs were very numerous. The anatomy is pretty well shown in the figures. The mouth end is the same in both sexes, but the posterior end is very different. The male shows several papillae both before and behind the anus and there are two short curved spicules.

Oxyuris simiae, sp. nov.

(Fig. 135)

Host—*Simia satyrus*.

Habitat—Colon.

Locality—Singapore.

In the intestine of a *Simia satyrus* at Singapore, there were found in the colon a lot of small *Oxyuridae*. They were very small and of a very delicate shape, nearly white in color. They are almost transparent. The mouth is terminal and surrounded by small papillae, not at all armed; it communicates with the pharynx by means of a long oesophagus, which terminates in a globular portion or valve. The wide intestine joins this directly by the intervention of a ring like structure. The vagina is at about the beginning of the posterior third of the worm. Eggs are small, yellow, and oval, tail very pointed, and the anus opens some distance from the tip, in a slit-like opening.

Measurements of O. simiae

Length	6.00 mm.
Width30 mm.

Both sexes are much alike in appearance.

Ankylostomum caninum

(Fig. 136)

Host—Kampong dog.

Habitat—Intestines.

Locality—Bali.

At Bali, on June 2, 1916, there were found in a kampong dog's intestines a lot of *Ankylostoma*. They evidently are *A. caninum*. A sketch of them, male and female, is shown in Fig. 136. They show the three characteristic teeth in the upper jaw, one small; the female being 11 mm. long by .40 mm. wide and the bursa is .60 mm. in longest diameter, and it is so constructed that it may open to receive the female in its clasp, having five rays on each wall. The spicule is single and rather long. As will be seen by the plate, the pharynx is a long and very muscular structure. The intestines are long and much curled, and in the female much intertwined with the uterus.

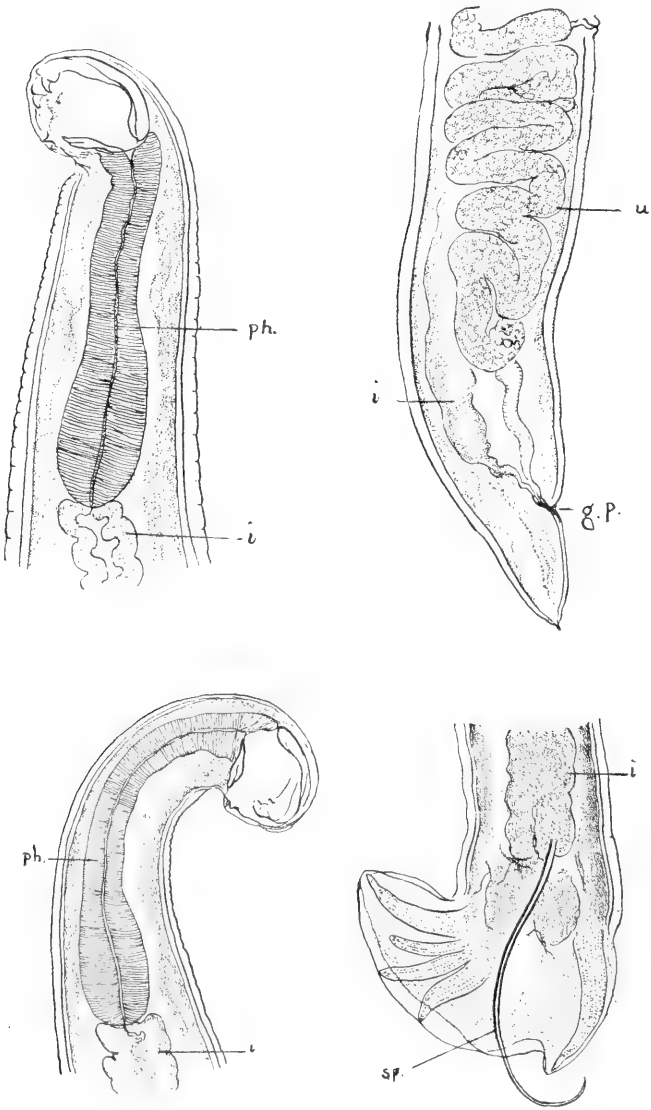
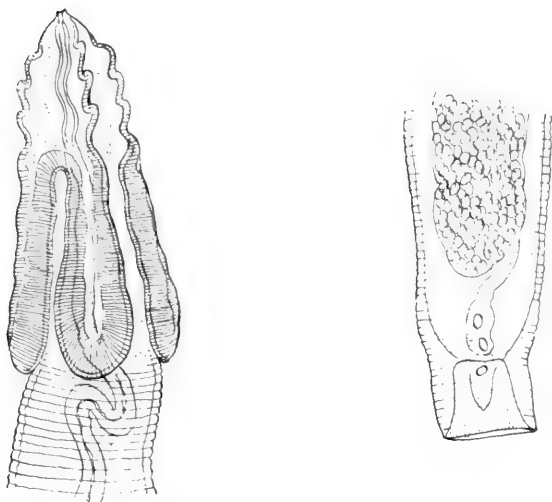


FIG. 136. *ANKYLOSTOMUM CANINUM*

FIG. 137. *DISPHARAGUS EGRETTAE*

Dispharagus egrettae, Rud. 1819.

(Fig. 137)

Host—*Egretta candidissima*.

Habitat—Intestine just posterior to the gizzard.

Locality—Zoological Park, New York.

These little worms were found in numbers on January 14, 1919, in that portion of the intestine just posterior to the gizzard. Some of them had their heads buried in the mucous membrane so far that they were removed with difficulty. There were no males found and it may be that, if they were very small, they were overlooked. As will be seen by the plate, the head is beautifully ornamented by four long, double, wing-like structures which to the worm are both useful as well as ornamental, for when buried in the mucous membrane, they would add much to its clinging power. These extend from the mouth towards the posterior .440 mm. expanding as they go until at the return bend they are .120 mm. wide. Their edges too are sharply notched, if they are not minutely spined. Across the base of what may be called the head, it measures .200 mm.

The oesophagus extends in a serpentine way from the mouth posteriorly and the mouth appears to be unarmed. The tip of the head is acutely conical and the sides of the head are margined by the ornamental structures which are wavy along the edge.

The posterior end of the female shows an odd cloaca containing both the genital pore and the anus in a cup-shaped structure, open

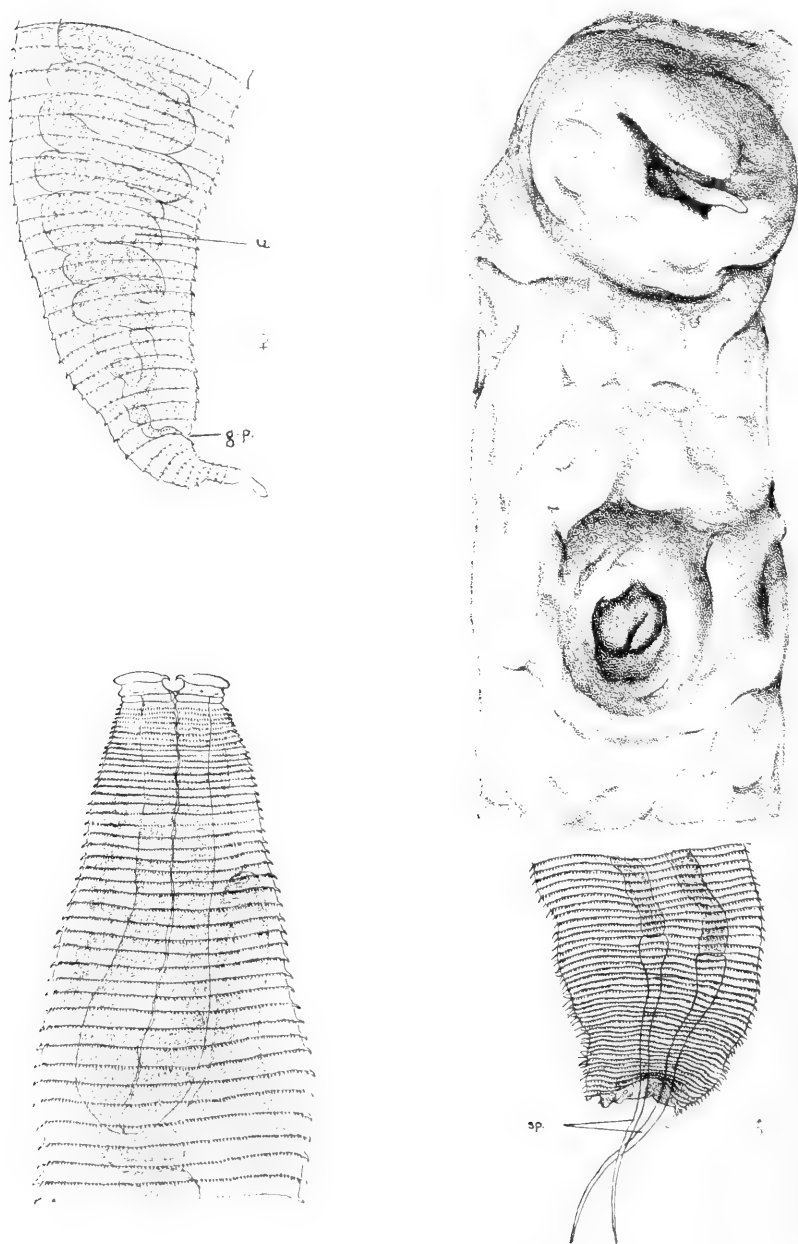


FIG. 138. *LECANOCEPHALUS ANNULATUS*

posteriorly. The other organs cannot possibly be made out in this material, for the body is literally filled with eggs. These are oval and colorless, .024 mm. long + .015 mm. wide. The body is from 10 — 11 mm. long and .440 mm. wide, and it is striated transversely throughout.

Lecanocephalus annulatus, Molin.

(Fig. 138)

Host—*Roccus lineatus*.

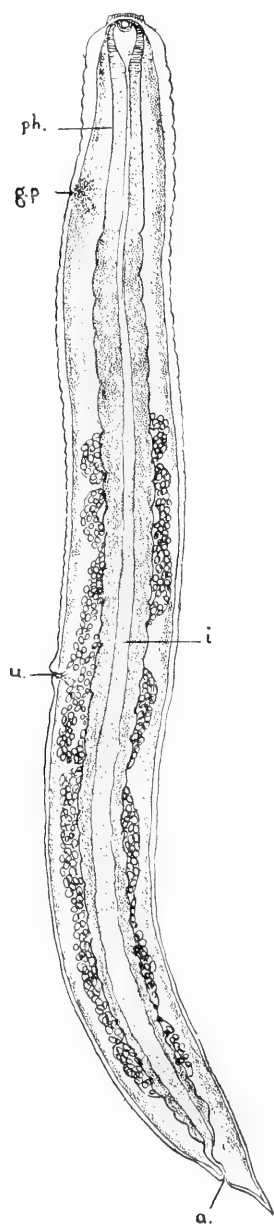
Habitat—Stomach.

Locality—Fish market, New York.

This worm, although small, undoubtedly is a serious pest to the fish it inhabits. Its mode of living is calculated to interfere very materially with the function of the stomach, inasmuch as it burrows under the mucous membrane, in fact excavating in some cases quite a space where several worms cohabit. The inlet to this habitation may not be large, yet as many as five or six worms have been seen with their heads protruding at the same time. This is probably done for the purpose of feeding on the chyme or contents of the stomach, for an examination of the contents of their intestines does not indicate that they live on the blood of their host. There are often several of these nests in the stomach, each nest may be 30 mm. to 40 mm. across, and as they cause a good deal of swelling and irritation, they may and do in some cases so restrict the cavity of the host's stomach that its food cannot be taken in any quantity sufficient to keep it alive. Thus the worms are a very serious menace to the fish. They are also quite cosmopolitan in their choice of a home, for they are found also in *Centropristes striatus*, sea bass, margate fish, *Hemulon album*, *Epinephelus striatus*, hake, alewife and many others (See Fig. 00.)

There appear to be three species of *Lecanocephalus*, *L. annulatus*, Molin; *L. spinulosus*, Dies.; and *L. kollari*, Molin. The present form seems to be the common one found in fishes of this continent. It is not large, the body is cylindrical tapering somewhat at each end and is covered with regular transverse rows of sharp spines, which all point backward.

The head is peculiar, having on each side of the mouth an overhanging plate of chitin with a sharp hook at the mouth end, apparently not for offensive purposes, but to retain the mouth or lips in contact with the mucous membrane. The mouth has three lips. The pharynx is a long, very muscular organ. The vulva is near the head. The sexes are separate and the female has a sharp pointed tail, spiny to the end, and the genital pore is a short distance anterior to the tip. The uterus is voluminous and it almost fills the abdominal cavity with transverse folds filled with eggs. The male posterior end is wide and has projecting from it two spicules which are not very

FIG. 139. *STRONGYLUS PATINI*

long. On its dorsal side is seen a short spine which is much larger than the usual spines covering the body. Other than this, the small spines in rows extend to the tip. Anal aperture in front of spicules oval in shape and marginal with very small, sharp spines. As usual with the nematodes, the females are much more numerous than the males, the latter being slightly smaller.

Measurements of L. annulatus.

Females Length	6.00 mm. to 7.60 mm.
Width	1.00 mm.
Males Length	5.00 mm. to 6.00 mm.
Spicules	2.00 mm.
S. exerted400 mm.
Terminal spine, end of male tail040 mm.

Strongylus patini, sp. nov.

(Fig. 139)

Host—*Ikan patin*.

Habitat—Intestines.

Locality—Bandjermassin, Borneo.

This worm was found on July 1, 1916, at Bandjermassin, Borneo, in the intestine of a large fish called locally *Ikan patin*. There seems to have been only one found, although the notes say that there were three. This one is a female, containing a large number of eggs in the uterus. The mouth is armed in an unusual manner, as it is surrounded by a circle of prominent spines and the mouth is circular, emptying into a funnel-shaped gullet, and the whole terminating in a muscular pharynx such as is common in the *Strongylidae*. This terminates in a large intestine which is continued to near the posterior tip of the body. At a point nearly half the length of the body is the opening of the uterus or vulva from which the eggs are extruded, and near the head on the same side is an opening, the genital pore. The skin is a good deal corrugated, especially near the head, but it is unarmed. The uterus is voluminous and in this case is filled with oval yellow eggs.

The male has not been seen, but probably it is bursated.

Measurements of S. patini

Length	13.00 mm.
Width	1.00 mm.
Width of mouth, surrounded by spines	.240 mm.
Eggs040 mm.
Width of mouth proper.....	.040 mm.
Across head320 mm.

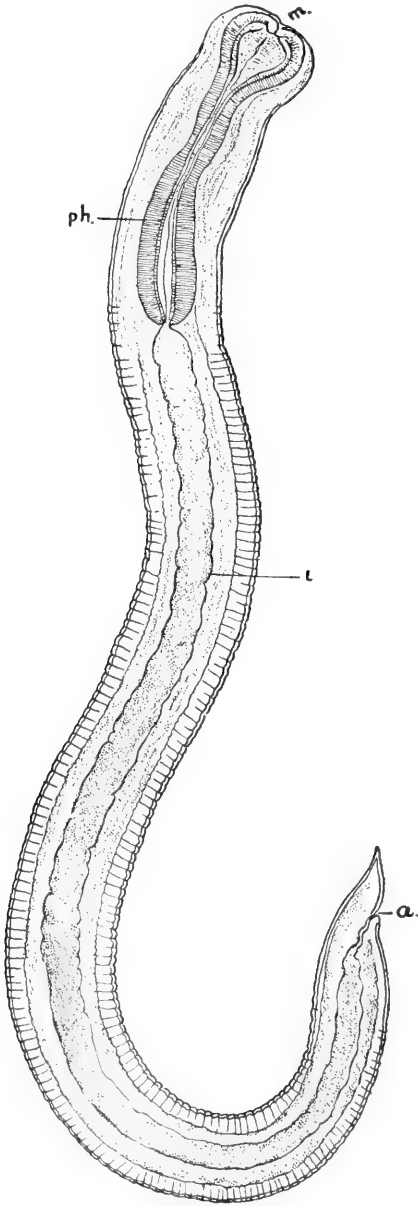


FIG. 140. *DACNITIS CARANGIS*

Dacnitis carangis, sp. nov.

(Fig. 140)

Host—*Caranx hippos*.

Habitat—Intestine.

Locality—New York Aquarium.

On May 29, 1917, there was found in the intestine of a *Caranx hippos*, crevalle, a small form which proved to be a *Dacnitis*. It is different in form of head to any hitherto seen and a sketch is given. The head is rather round, and when rendered transparent is seen to be composed of two armed jaws, which are capable of enclosing the upper part of the oesophagus. This latter also during its passage through the head portion is armed. The mouth proper is small and round, and is placed at the anterior end of the head. On each side, too, of the gullet is a semilunar space which is thickly studded with minute spines. The pharynx is a long, bag-like, muscular structure, down the centre of which runs the oesophagus which terminates in the intestine. This latter runs to the end of the tail almost.

The whole worm is small, being only about 10 mm. long and very delicately formed. It is striated transversely throughout the whole length from the end of the pharynx to the tip of the tail.

Dacnitis sphaerocephalus, Dujardin.

(Fig. 141)

Host—*Acipenser sturio*.

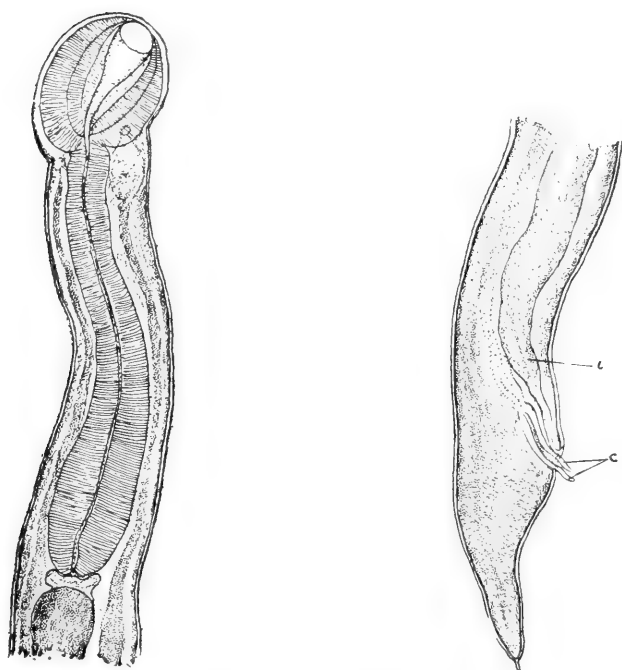
Habitat—Stomach.

Locality—New York Aquarium.

There were only two of these worms found in the sturgeon harboring them, and unfortunately they are both males. However, as they are rare, it is thought worth while to record the find. The female, as usual in the nematodes, is larger than the male, but the construction of the head is exactly the same, as is the rest of the anatomy, except of course the genitalia.

These worms are of separate sexes and are usually viviparous.

The mouth is an unusually muscular structure, but it cannot be said to be provided with lips. It is apparently the large end of a funnel-shaped gullet which ends in a very powerful pharynx. It, the gullet, is strengthened on each side by at least two strong longitudinal muscular rolls and on one side of the neck very near the head, there is a delicate structure which might be called a gland—a head gland with a long tube running posteriorly by the side of the pharynx. The skin is slightly and regularly striated throughout.

FIG. 141. *DACNITIS SPHAEROCEPHALUS*

The posterior end of the worm is usually coiled somewhat, and presents within .400 mm. of the tip, the anus and the protruding cirri, the anus in front. The cirri appear of an equal length, and form a triangular pointed organ which looks almost as if single. The spicules are not long and the papillae are so exceedingly small that they are seen with difficulty. In one case there are two pairs of preanal papillae of fair size, but if there are more, they are almost invisible. The post-anal ones also are very small, but there seems to be eight or ten pairs. The tip of the tail is surmounted by a short spike and just anterior to this are two pairs of what seem to be spicules a long way separated from the others.

Measurements of D. sphaerocephalus

Width280 mm.
Length of pharynx.....	1.60 mm.
Across base of pharynx.....	.040 mm.
Across head400 mm.
Across neck360 mm.
Across mouth proper.....	.120 mm.

Echinocephalus aetobati, sp. nov.

(Fig. 142)

Host—*Aetobatis narinari*.

Habitat—Spiral valve.

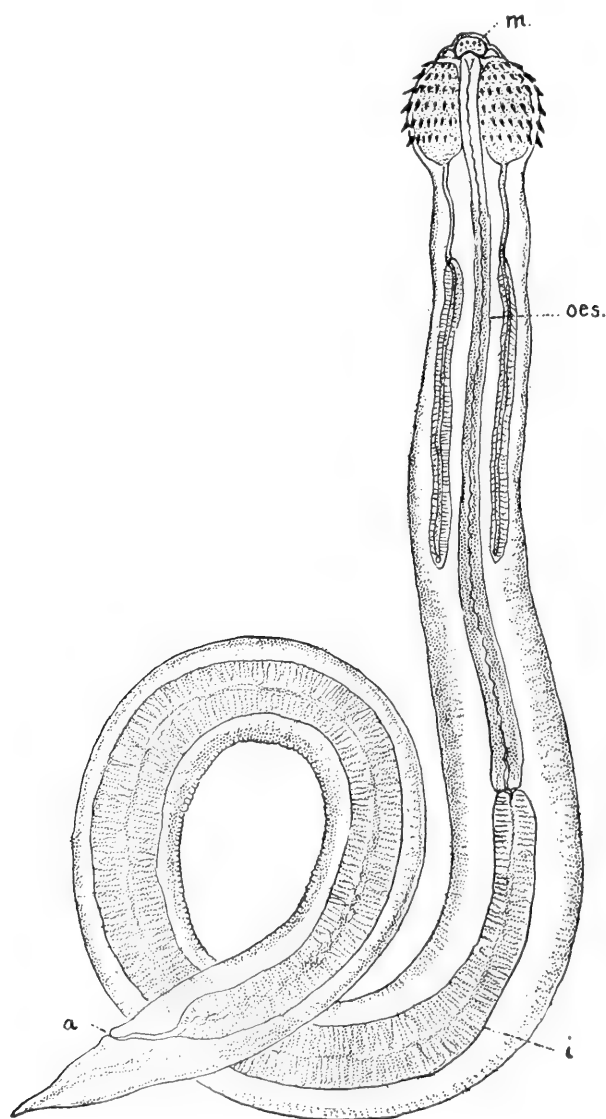
Locality—Batavia, Java.

This remarkable little nematode was taken from the spiral valve of an *Aetobatis narinari* at Batavia, Java, by W. G. MacCallum, on May 25, 1916.

Only one was found, and it seems to be a young and undeveloped female. I have a faint recollection that Monticelli described such a worm under the name *Echinocephalus striatus*, but I can find no literature on the subject, so think it best to put the find on record. As will be seen (Fig. 142), the head is the peculiar feature, being almost globular and surrounded by six transverse rows of spines. The mouth apparently is studded with spines. The anterior semi-circular lip has spines on its inner surface, and the lower triangular shaped lip also has spines on it. The mouth enters at once into a long oesophagus which is nearly half the length of the alimentary canal. On each side of the oesophagus, and within the globular-shaped head is a large rounded gland which may be called a head gland. These communicate by a narrow tube with two wide tubes or reservoirs, which extend nearly one-fifth of the length of the worm. The head was not sectioned so that it cannot be said certainly that there is any connection with the mouth, but the inference is that there is. In that case, the secretion probably has the same properties as that of many other nematodes—the *Strongylidae*, *Uncinaria*, etc., having a poisonous effect upon the host. The skin is closely striated transversely, but unarmed. Tail terminates in a spike and the anus is situated .320 mm. from the tip.

Measurements of E. aetobati.

Length	7.00 mm.
Width360 mm.
Neck280 mm.
Across mouth.....	.080 mm.
Longest spines on the head.....	.032 mm.
Across head360 mm.
Length of head.....	.240 mm.
Length of narrow tube leading to reservoir	.200 mm.
Length of reservoir.....	1.120 mm.

FIG. 142. *ECHINOCEPHALUS AETOBATI*

Strongylus boae, sp. nov.

(Fig. 143)

Host—*Boa constrictor*.

Habitat—Stomach.

Locality—Brazil.

These worms were found first in the stomach of a *Boa constrictor* from Brazil, and afterwards similar worms were found in the gullet of *Zamenis contortrix*, and in the stomach of a *Boa mexicana*, also in the stomach of a hog-nosed snake. They are all certainly alike, being more or less black throughout the greater part of the body, but the head and neck are white as is also a portion of the posterior end. The female is about 8 mm. long and the male 6 mm. The latter is provided with a copulating bursa which shows nine rays on a side and two spicules of about equal length emerging from the posterior part between the rays. The mouth is an unusual structure, being terminal, but immediately behind and connected with it are three short, longitudinal, chitinous pillars with apparent spaces between them, and the opening of the pharynx is at the base of these. The pharynx is muscular and is followed by a long stomach and intestinal tract, all of which are generally full of black material, probably partially digested blood. The anus is near the tip of the tail and the genital pore is about one-quarter of the length of the worm from the tip of the tail. The uterus is generally filled with numerous eggs of good size relatively. A large species of this same genus was found in the stomach of a *Python sebae* from the Congo. It was, however, yellow in color and was 15 mm. long for the female and 12 mm. for the male. Other than these differences the worms are very similar.

Stossich describes a strongyle female, no male, seen from an East Indian python. It only measures 7 mm. This he named *S. ersiliae*.

Agamonema scorpaenae cirrhosae, Dies.

(Fig. 144)

Host—*Scorpaena cirrhosa* (Cuv.)

During January, 1917, there were found in a *Scorpaena cirrhosa* two very small and delicately formed strongyles, male and female only about 10 mm. long by .20 wide.

Both sexes have the anterior end much curved. The mouth does not seem to be armed, but is terminal and circular or rather slit shaped. It opens into a long straight pharynx, which in proportion to its size, is quite muscular. The skin near the head is expanded

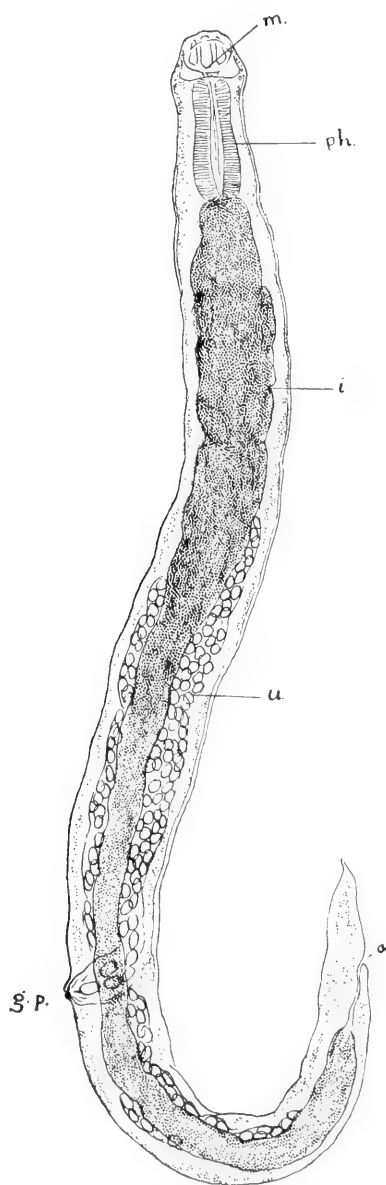
FIG. 143. *STRONGYLUS BOAE*

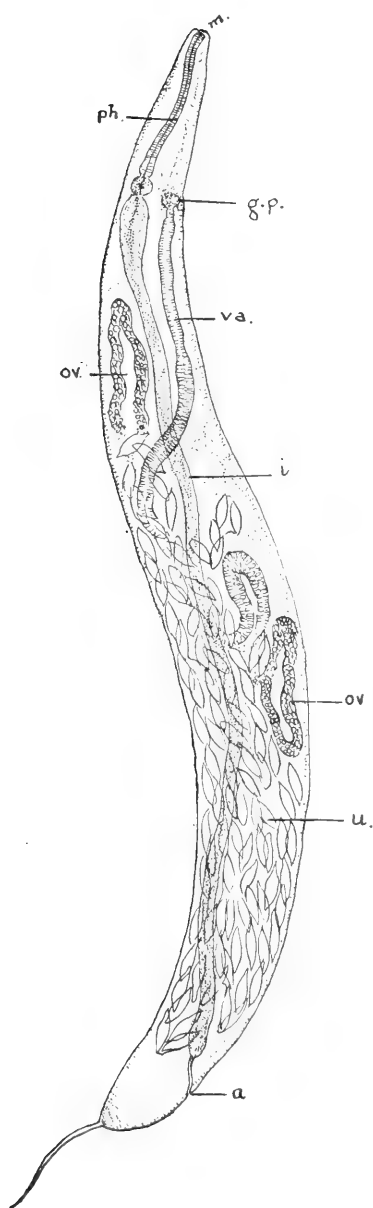
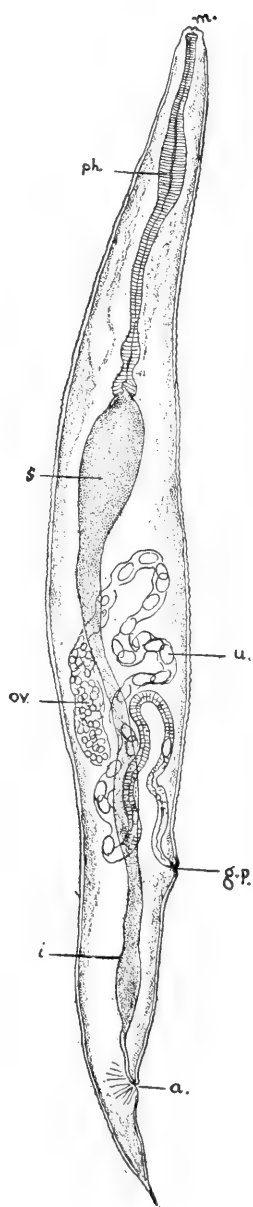
FIG. 144. *AGAMONEMA SCORPAENAE CIRRHOSAE*

from the head proper, apparently for the purpose of enabling the worm to retain its hold on the mucous membrane. At its junction with the intestine in both sexes there is a short, dark mass in each side of the intestine.

The genital pore or vagina is situated about one-third of the length of the worm from the tail. This locality is certainly peculiar. The vagina goes across the worm almost to the opposite side, entering a peculiar, large, lobulated mass which seems to be composed of numerous tubules, forming a beautiful structure which all finally terminates in the uterus. This organ is tubular and some of the coils extend quite towards the end of the tail. The anus is very near the tip of the tail, which ends in a very sharp spicule. The male has a delicately formed, small bursa containing about twelve rays. There are two spicules of a bright yellow color and comparatively thick. The two points of peculiarity in the anatomy of this worm are the structure of the mouth and the mass about the genital pore. The mass near the genital pore is .80 mm. across and 1.60 mm. in length. The cloaca is a relatively deep notch with swollen lips and the vagina extends into the mass to almost the whole width of the structure, and nearly the whole width of the worm, which is at this point 1.25 mm. It is unlike any structure observed in any known worm. No eggs can certainly be seen in this specimen. The worm may be a worm called *Agamonema scorpaena cirrhosae*, (Dies).

Measurements of A. scorpaena cirrhosae.

Length of female.....	10.00 mm.
Width of female.....	1.20 mm.
Length of male.....	8.00 mm.
Width of male.....	1.00 mm.
Length of spicules.....	1.20 mm.

FIG. 145. *OXYURIS PTYCHOZOONI*FIG. 146. *OXYURIS IGUANAE*

Oxyuris ptychozooni, sp. nov.

(Fig. 145)

Host—*Ptychozooni hemalocephalum*.

Habitat—Rectum.

Locality—Buitenzorg, Java.

On May 24, 1916, at Buitenzorg, Java, there were found a lot of small Oxyuridae in the rectum of a *Ptychozooni hemalocephalum*, a small leaf-like lizard. They are five or six millimeters long and only .20 mm. wide. There were no males among those examined. The females were filled with relatively large eggs, they being .600 mm. long \times .120 mm. wide. The worms are almost white and were rendered quite transparent. The mouth is terminal and surrounded by small papillae. The oesophagus is long and narrow, terminating in a round ball-like portion of the pharynx. This is followed by a narrow portion before emptying into the intestine. The anus is situated a short distance from the posterior end of the body. The genital opening is seen almost opposite the ball-like pharynx. At the end of the vagina there is seen a structure which is probably the ovary. The uterus fills almost the whole of the rest of the body cavity. The genital pore is posterior to the anus a short distance. At the posterior end of the body is a fairly long spicule, much like that in the *Oxyuris* of *Blattae orientalis*.

Oxyuris iguanae, sp. nov.

(Fig. 146)

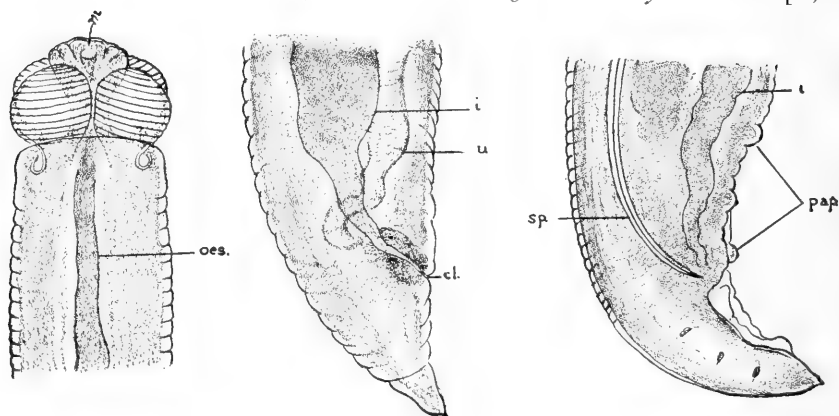
Host—*Iguana tuberculata*.

Habitat—Intestines.

Locality—Zoological Park, New York.

This small worm was found in great numbers in the rectum chiefly, of all the iguanas examined. It differs considerably from the Oxyuridae from other reptiles or animals from South America.

The most notable feature is the alimentary tract beginning with a small mouth which has many fine sharp denticles on the lips and also within the mouth. The pharynx which follows is exceedingly long relatively and widens at intervals. It is transversely striated like the pharynx of the strongyles, and on each side is to be seen a tube leading up to the head. It extends nearly one-third of the length of the worm and empties into a wide fusiform portion which probably serves as a stomach and this organ gradually narrows into an intestine which extends to nearly the posterior end of the worm, where it opens externally within a short distance of the sharp pointed tip. The genital pore is situated at about the junction of the posterior

FIG. 147. *ASCARIS TIARA*

quarter and anterior three-quarters of the length of the worm. The eggs are oval, large and few, and seem to need a metraterm to expel them from the uterus. The skin is smooth and finely striated throughout. The ducts seen on each side of the pharynx are probably analogous to the head and oesophageal glands seen in the strongyles, and probably have the same function. No males recognized.

Measurements of O. iguanae

Length	7.00 mm.
Width, maximum.....	.80 mm.
Eggs120 × .080 mm.

Ascaris tiara, v. Linstow, 1879.

(Fig. 147)

Host—Monitor, *Varanus salvator*.

Habitat—Intestine and Stomach.

Locality—Buitenzorg, Java.

On May 27, 1916, a lot of these worms were found in a large monitor and although this worm was first discovered and described by V. Linstow, having found it in a *Varanus ornatus*, Daud. in Natal, Africa, it has been thought worth while to record this one. The fact that it was found in another species of *Varanus* and in Java, geographically, so far distant from those found in Natal, makes it necessary to report it. Beside the above reasons, it is not very easy to find a good figure of the worm, and as it will be seen at once, it is very different morphologically from any other *Ascaris*. I may

say that I have no literature on the subject so am not sure that it is an *Ascaris* at all.

The head is a very odd structure which once sunken into the mucous membrane of the intestine would be a very efficient attachment in addition to its ornamentation.

The worm is whitish in color and as usual the female is larger than the male. There is a considerable difference in the size of the worm from *V. ornatus*, and this species from *V. salvator*, those as given by Von Linstow from *V. ornatus* being female 28 mm., male 20 mm., while the worms from *V. salvator* are female 37.50 mm., male 30 mm.

The cloaca is on the ventral side near the posterior end. In the female the end of the body terminates in a short strong spine. The male has a number of papillae near the posterior end four of which are larger than the rest, and three are preanal and four of varying size post-anal, while along each side are three more. These latter are small. There is also a sort of membranous trough or bursa between the anus and the tip of the body. The cirri are as Linstow says, sabre-form. The skin is deeply striated and the bulbous lips at the head are striated. The skin is thick. The eggs are numerous and fairly large, and rather round.

Measurements of A. tiara.

Length	37.50 mm.
Male	30.00 mm.
Width	1.50 mm.
Across head480 mm.
Across each lip.....	.240 mm.

Sclerostomum tribulbocapitis, sp. nov.

(Fig. 148)

Host—Blanding's turtle.

Habitat—Stomach.

Locality—Ohio.

These worms were found at Wood's Hole on August 5, 1919, in the stomach of a Blanding's turtle and in one case had formed a cavity or nest under the mucous membrane, and in every case where they were attached to the membrane, they had sunk their triangular lobulated heads quite deeply beneath the mucous lining.

It is not a very large worm, nor was it found in great numbers, one or two pairs at most in each host. In size, it is male 24 mm. long, female 25 mm. and quite slender. The head is triangular in shape, in fact seems to be composed of the three globular masses

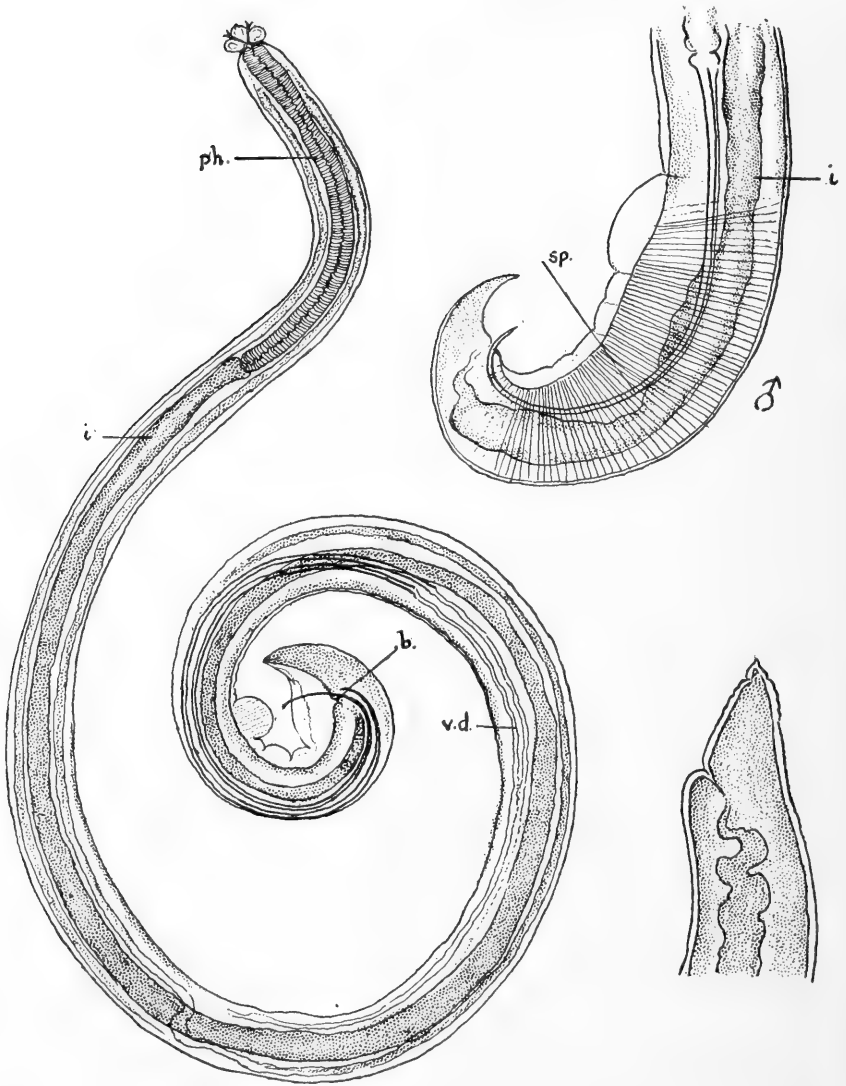


FIG. 148. *SCLEROSTOMUM TRIBULOCAPITIS*

joined together, and separated from the body by a very decided neck. The mouth part, opens apparently by the upper jaw, raising perpendicularly and the two globular masses at the sides being the angles. A long oesophagus follows the mouth and on each side of this is a tube, called the head gland in these worms and which in some cases gets the credit of carrying a noxious or poisonous fluid to the parts incised by the jaws.

In the case of the female the genital opening appears to be situated near the centre of the length of the worm. The anus is at the posterior, very near the end. No eggs are seen but the uterus is filled with larvae.

The male is nearly as long as the female and is supplied with a complicated bursa and two long spicules. The tail of the worm extends curved, and a membrane which is double, surrounds the tip and extends anteriorly, widening as it proceeds, and directly at the end it narrows and becomes attached to the body, a shell-like transparent structure intervening. Near the tip of the body itself are shown several prominent spikes standing out on the surface, three on the outer curve, and five within the curve, one being anterior to the outlet of the spicules. The spicules arise from among them near the end and at their interior end the testes may be seen attached to the spicules, the whole end forming a complicated and beautiful structure.

Measurements of S. tribulocapitis.

Length	24.00 mm. \times 27.00 mm.
Width	1.00 mm.
Across head12 mm.
Immediately behind head...	.20 mm.

Sclerostomum lopholatilus, sp. nov.

(Fig. 149)

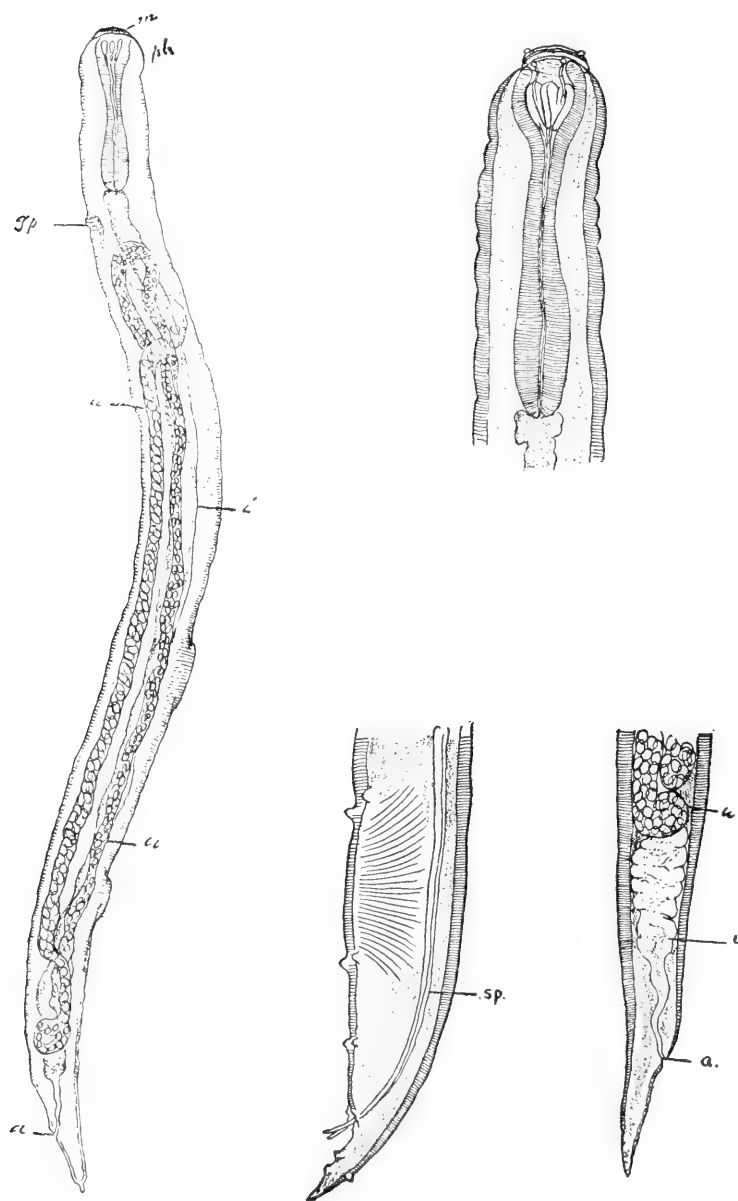
Host—*Lopholatilus chamaeleonticeps*.

Habitat—Intestine.

Locality—New York Aquarium, New York.

These odd little worms were found on October 26, 1915, in the intestine of a tile fish. They were found firmly adherent to the mucous membrane.

The mouth is surrounded at the lips by a circle of evenly placed spines which enables the worms to retain their hold while deriving their nourishment. The oesophagus is very muscular and seems to extend to the mouth without the interposition of a pharynx. The oesophagus however widens near the mouth and contains three tubular structures which may be suckers. These are unusual organs.

FIG. 149. *SCLEROSTOMUM LOPHOLATILUS*

The uterus filled with large round eggs extends from its outlet, the genital pore, to near the anus and occupies the greater part of the abdominal cavity. The genital pore is situated near the posterior end of the oesophagus.

The skin is thick and is striated with deep transverse lines. The anus is very near the posterior end of the body which terminates in a sharp point.

The male is much smaller than the female, being only about half its size. It has a coiled tail and on the ventral side of the posterior end are five pairs of pointed papillae and one on the dorsal side near the tip. Near the tip also two spicules make their exit. They are proportionally

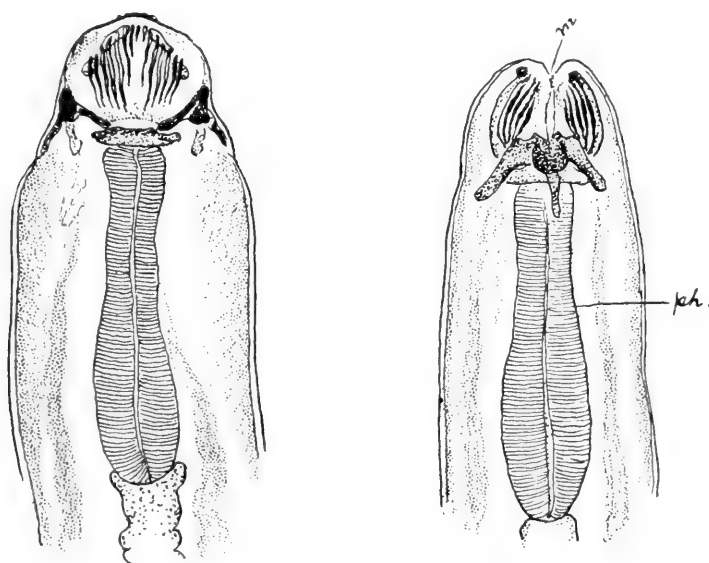


FIG. 150. *CAMALLANUS TESTUDINIS*

long but there is no bursa. Between the two first pairs of papillae there are a number of transverse muscular striae, used for holding purposes during coition.

Measurements of S. lopholatilus.

Length of female.....	10.00 mm.
Width of female5 mm.
Length of male6 mm.
Width of male250 mm.
Across head back of mouth5 mm.
Width of mouth250 mm.
Eggs06 × .04 mm.

Camallanus testudinis, sp. nov.

(Fig. 150)

Host—Blanding's tortoise.

Habitat—Stomach.

Locality—Ohio.

This little *Camallanus* was found in varying numbers in almost every specimen of seventeen Blanding's turtles which were examined, but never in very great numbers as *Camallani* are sometimes seen in other hosts. They were chiefly located at the entrance of the stomach and end of the oesophagus.

They were generally found with the head firmly embedded in the mucous membrane. They were reddish in color when first collected but the pink tint soon faded after exposure to the air. They did not seem to have withdrawn blood, for the contents of the intestines were not black. The mouth is of much the same structure as usual except that it was in these often found closed from side to side,—that is, the chitinous teeth came together in a line from the mouth to the throat, thus showing the way in which the mucous membrane is broken or bitten. As a reference to the plate will show, an old u-shaped structure, not seen in any other plate, is also plainly to be seen, perhaps, only brought anteriorly to view, when the mouth is closed. Its function may be to facilitate the sucking process. The rest of the anatomy of the body seems similar to most of those *Camallani* described in *Zoopathologica*, Vol. 1 No. 5, July 1918. The uterus, in almost every case, was filled with larvae of different degrees of development. They varied in length from .02 mm. to .03 mm. long and .002 mm. wide. The head always shows a little wider than the body. The vaginal opening is situated about the middle of the length of the body of the adult female, and presents swollen lips.

The female is generally about 14 mm. long and the male about 7 mm. long. The female is nearly twice as wide as the male.

Sclerostoma eustreptos, sp. nov.

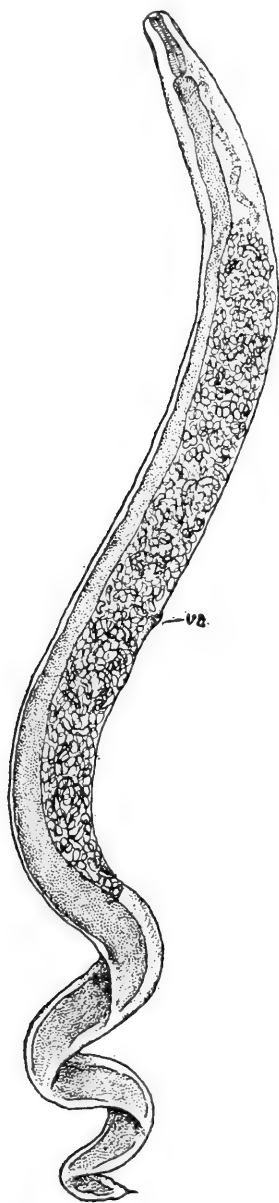
(Fig. 151)

Host—*Ophibolus getulus*.

Habitat—Lung.

Locality—Zoological Park, New York.

This little worm of which there were a number found in the lung of a king snake, *Ophibolus getulus*, on July 25, 1919, from the Zoological Park, N. Y., is of such remarkable conformation that it becomes necessary to describe it. This is not very easy on account of its shape, however, the mouth is more or less circular and is armed on the

FIG. 151. *SCLEROSTOMA EUSTREPTOS*

inner margin of the thick lips with a row of small teeth. The oesophagus or pharynx is flask-shaped and anteriorly it extends to the lips, the posterior portion is widened and the length of this cross striated muscular portion is .40 mm. \times .10 mm. wide. It terminates in the intestine without any great enlargement on the part of the intestine, this latter is filled with granular matter and it widens somewhat as it proceeds posteriorly. It preserves its light color for a certain distance but then becomes pigmented and remains so almost to the end of the body, showing a distinct line of demarcation between it and the generally over-distended uterus. It is not so much pigmented, however, that the eggs may not be seen through it, while it overlays that portion of the uterus which is filled with larvae. It terminates at the anus, which is very near the tip.

Near the anterior end may be seen what appear to be the ovary and testis, both in the form of tubes filled with granular matter. They extend to within a short distance of the posterior, or flask-shaped end, of the oesophagus, and pass behind the uterus towards the posterior end. A very narrow tube may be seen to pass on each side of the oesophagus quite to the margin of the lips. They seem to be filled with fine granular matter which may be projected into the wound made by the bite of the worm, possibly with toxic effect. There is no pharynx. The worm is viviparous and the uterus crowded with larvae fills the greater part of the body. These latter have a distinct shaped head and a sharp tail and exist in myriads. There are also eggs in all stages of development, from the freshly formed to the fully developed larvae. The genital pore is situated about the middle of the worm on the uterine side. The peculiarity in the anatomy of the worm is that about one-fifth of its length posteriorly is in the shape of a cork screw, and besides the margins of this section are membranous and transparent. The tip terminates in a sharp spine. No separate male was seen.

Measurements of S. eustreptos.

Length	7.00 to 8.00 mm.
Width	1.00 mm.
Width, across head.....	.50 mm.
Length of muscular oesophagus..	.40 mm.
Length of partly developed larvae	.20 mm.

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A BOT-FLY PARASITIC IN MONKEYS*

BY R. C. SHANNON AND C. T. GREENE

Bureau of Entomology, U. S. Department of Agriculture

(Figs. 152-153).

Two great rarities have recently been received by the U. S. National Museum, which, combined, add some very valuable information to our knowledge of the Cuterebrine bot-flies.

The Cuterebrinae apparently are peculiar to America. Five genera, *Dermatobia*, *Pseudogametes*, *Rogenhoferia*, *Cuterebra*, and *Bogeria* are included in the group. *Dermatobia* has a wide variety of hosts, parasitizing man, monkeys, dogs, cattle and birds, but the others (except for the unknown habits of *Rogenhoferia*) seemingly are addicted to the use of rodents and opossums for their hosts. Occasionally, individuals of the Cuterebrini will be found parasitizing other hosts, as cats, dogs and hogs, but these cases are regarded as accidental.

The material now at hand shows that certain Primates may serve as natural hosts for at least one species of *Cuterebra*. This exceptionally valuable material consists of two lots, the first being the neck portion of the hide of a howling monkey (*Alouatta palliata inconsonans* Goldman) which is so heavily infested with the bots that the hide has the appearance of a collection of cells in a bumble-bee's nest. This specimen was collected by the late Mr. J. L. Baer of the "Marsh Darien Expedition," in Darien, Panama.

The second lot of material was collected at Kartabo, British Guiana, by Professor Alfred Emerson of the Pittsburg University. It consists of two reared adults and a number of larvae taken from the howling monkey of British Guiana.

Apparently the howling monkeys are heavily parasitized by these bots. Emerson reports that they are numerous in the monkeys, usually in the region of the throat; and Goldman states in his "Mammals of Panama" (Smithsonian Miscellaneous Collections, 69, 1920, 229) "All of the specimens of (*Alouatta palliata inconsonans* Goldman) obtained, carried numerous large larvae of flies, mainly in the skin on the throat, which added materially to their repugnant appearance. These larvae were not found on the spider monkeys taken in the same vicinity. Perhaps the greater activity of the latter may prevent the deposition of eggs."

The fact that the bots are usually found in the region of the throat may afford a clue as to the method in which the monkeys become parasitized. Very little is known of the egg laying habits of the Cuterebrae but from what is known it appears that the female lays the eggs about the haunts of the hosts, perhaps on the leaves of plants. The eggs may then be eaten along with the leaves by the host animal and the larvae immediately upon being taken in the mouth probably emerge and begin to penetrate the tissues of the mouth, then

* Contribution, Department Tropical Research No. 195.

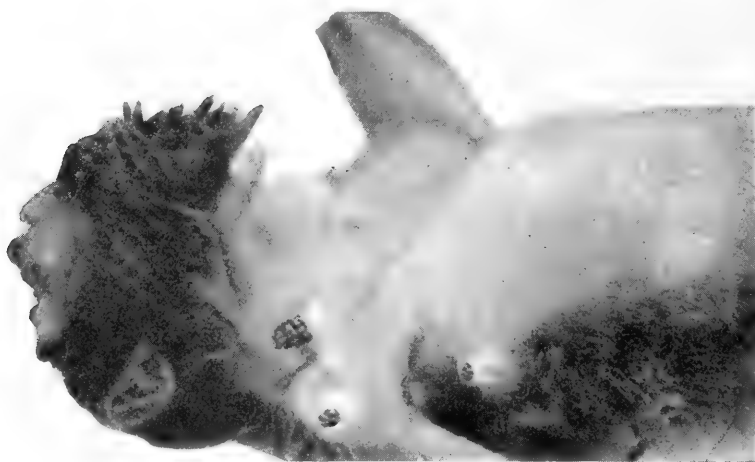


FIG. 152. A RED HOWLER MONKEY INFESTED WITH BOTS
 Photograph from a specimen collected by Alfred Emerson at Kartabo, Bartica
 District, British Guiana.

working their way through the flesh, they come to the skin of the host through which a breathing and exit hole is made. There they stay, in a pocket just beneath the skin, until full-grown. Upon emergence they fall to the ground where they pupate.

The material recorded proves to be a new species, and is here described under the name of *Cuterebra baeri* Shannon and Greene. The adult specimens have been selected as the types.

Cuterebra baeri, Shannon & Greene, sp. nov.

Fig. 153

Larva.—Typical form of *Cuterebra* (a) black, very rugose subshining, slightly flattened and slightly pointed towards the cephalic end. Nine visible segments besides the small head segment which is generally retracted. The chitinous dermal appendages completely cover the surface of the larva. These appendages are broadly rounded, flattened and fitted in shingle fashion (b). On the anterior two-thirds of each segment these dorsal appendages are directed backward; the edges of these appendages are yellow and smooth; here and there is an appendage having fine irregular teeth along the edge; then there is a single row of underlying appendages and from this row backward, covering the basal third of each segment, these dermal appendages are directed forward and all have fine, irregular teeth along the edge. Head segment and area around it luteous. From in front the head segment appears like two small, rounded lobes with the surface scale-like; each lobe has two microscopic tubercles, one above the other, on the anterior surface. Beneath each of these two cephalic lobes is a large, well-developed mouth hook. Anterior spiracles are of an orange color, large, elliptical and made up of closely set hairs resembling a broad flat brush. Posterior end (c) depressed into a shallow cavity around the edge of which the dermal appendages are not so broad but the teeth are more prominent. Spiracular plates (d) are about twice as long as wide and separated by a fine lyrugose, raised area; surface of each plate with a faint, indefinite

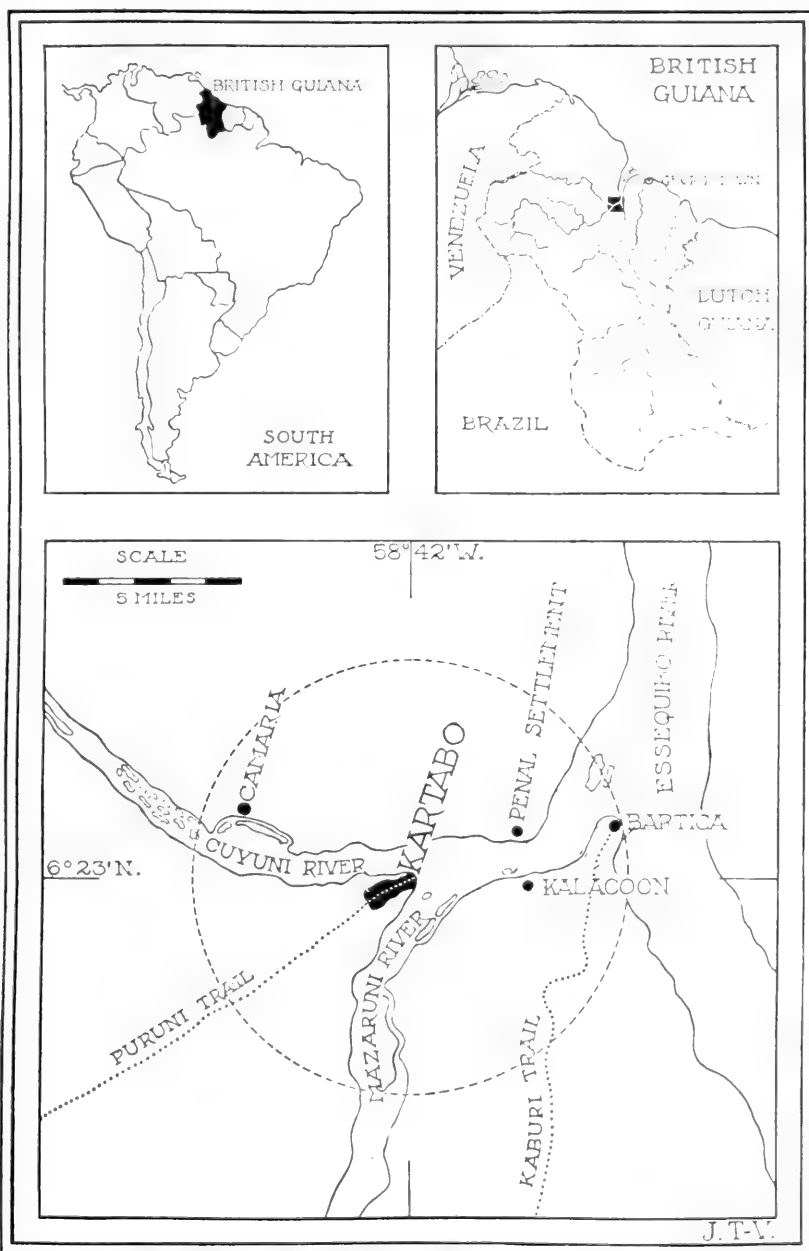


Plate A. British Guiana Tropical Research Station of the New York Zoological Society.
Circle represents a radius of six miles

Drawing by John Tee-Van

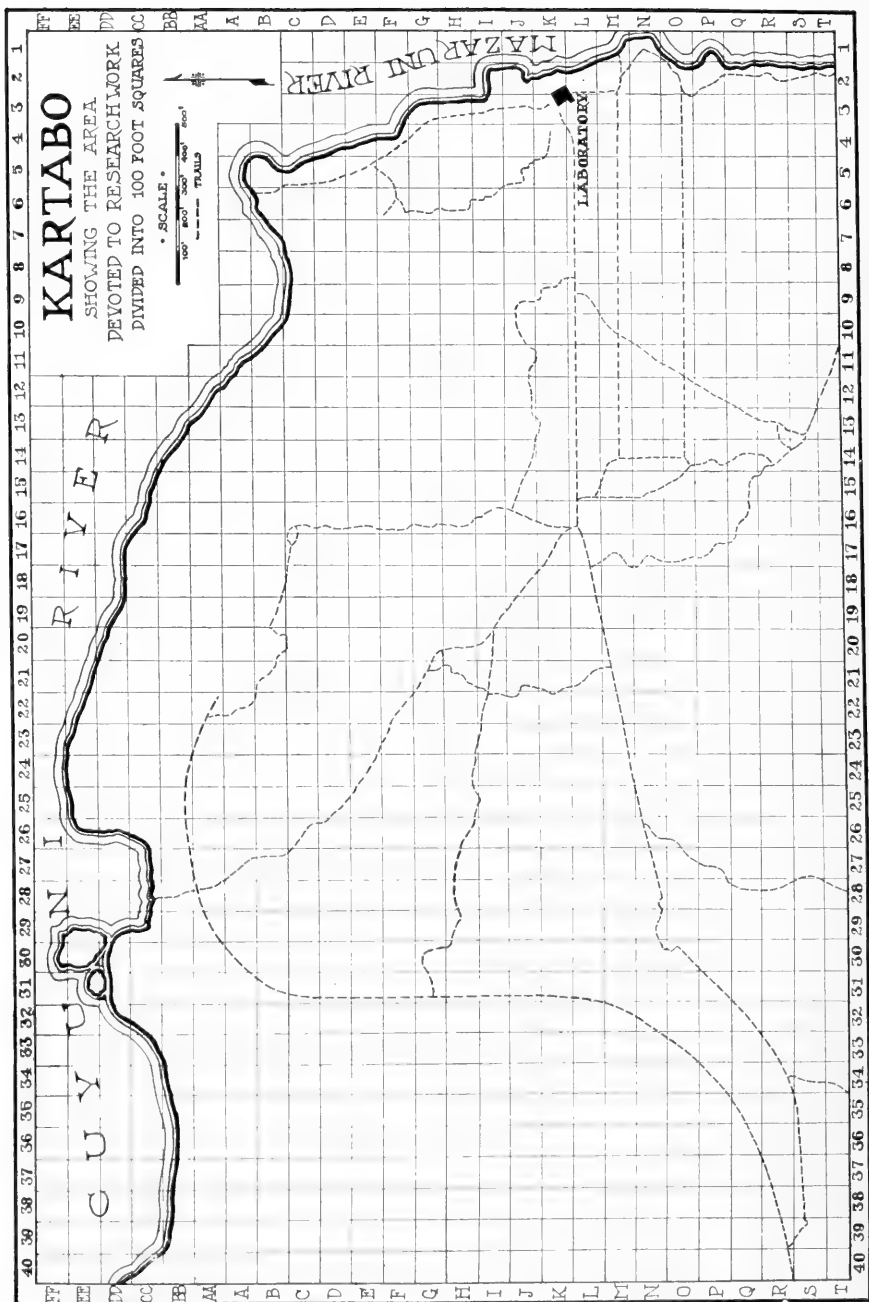


Plate B. Area devoted to research at Kartabo.
Drawing by John Tee-Van.

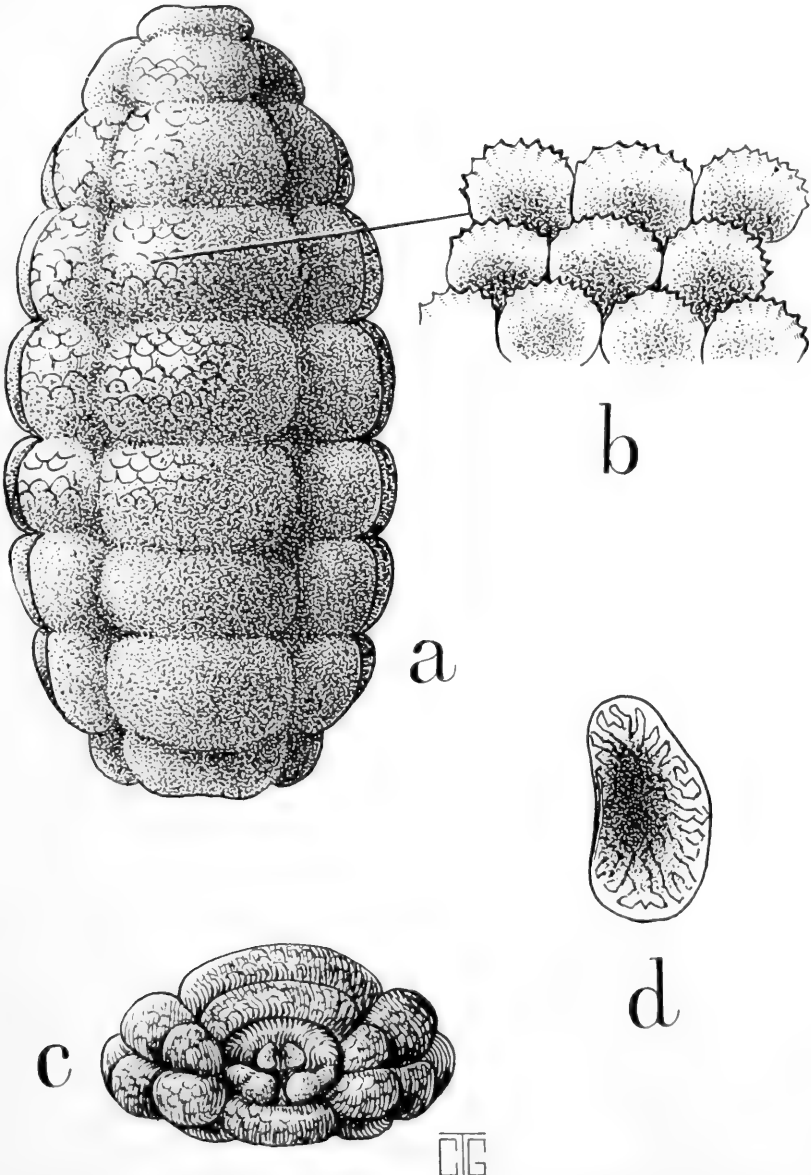


FIG. 153. *CUTEREBRA BIERI*, SHANNON AND GREENE, SP. NOV
From a Pen Drawing by C. T. Greene.

depression in the central area; the slits are quite indistinctly broken and of the serpentine type; no button; area around the spiracular plates shining with numerous rugosities and the surface with scattered, sharp pointed spines. Below each spiracular plate is a large rounded, raised surface with the surface having a scale-like appearance.

Length 22-27 mm., width 15 mm.

This type of larva is easily separated from other *Cuterebra* larvae by the dermal appendages being scale-like while in the other *Cuterebra* species the dermal appendages are cone-like and sharp-pointed at the apex and not so closely set together.

"Larvae emerged from red howling monkey on 12. VII, 1924. Probably pupated 12. VII, 1924."

Pupa.—About the same as the larva except the segmentation is slightly more pronounced.

Adult.—*Cuterebra baeri*, new species. Female: The species appears to be intermediate between *Cuterebra* Clark and *Bogeria* Austen as defined by Townsend. The peristomalia distinctly converged as in *Cute.ebra* but the antennal pit is circumscribed below as in *Bogeria*. In general coloration it is nearly entirely dark, and without grayish pollinosity, thus appearing closest to *Cuterebra tenebrosa* Coquillett, a western United States species which is usually found around the nests and burrows of pack-rats (*Neotoma*). Apparently no Neotropical species has this type of coloration.

Head entirely black; frontal triangle subtriangular, the apex not unusually produced; third antennal joint about two and one-half times longer than broad; arista fairly long; thoracic pile entirely black, very short on disc of mesonotum; legs black with black pile and strong hairs; abdomen black with basal dark brownish bands on second and third tergites; wings yellowish-brown basally and on basal three-fourths of anterior margin; tip of wing smoky and remainder of wing hyaline.

Length, about 18 mm.; wing, about 15 mm.

Type locality.—Kartabo, British Guiana, July 22, 1924.

Type.—Cat. No. 28163, U. S. N. M.

Female type, female paratype, both reared specimens, and a number of larvae, obtained from the red howler, *Alouatta* species (collected by Alfred Emerson). Also a large number of larvae, probably the same species, in the hide of the Panama howler, Darien, Panama, 1924 (collected by J. L. Baer).

Only one other species of *Cuterebra*, *maculosa* Knab, has been recorded from Panama. It differs by its much larger size and the presence of maculated pollinosity on the third tergite. The dark color of *Cuterebra baeri* will serve to separate it from all other Neotropical species.

Named for the late Mr. J. L. Baer of the Smithsonian Institution, who collected the specimen recorded above shortly before his untimely death.

A NEW ECTOPARASITIC TREMATODE

Epibdella melleni, sp. nov.

BY G. A. MACCALLUM, M.D.

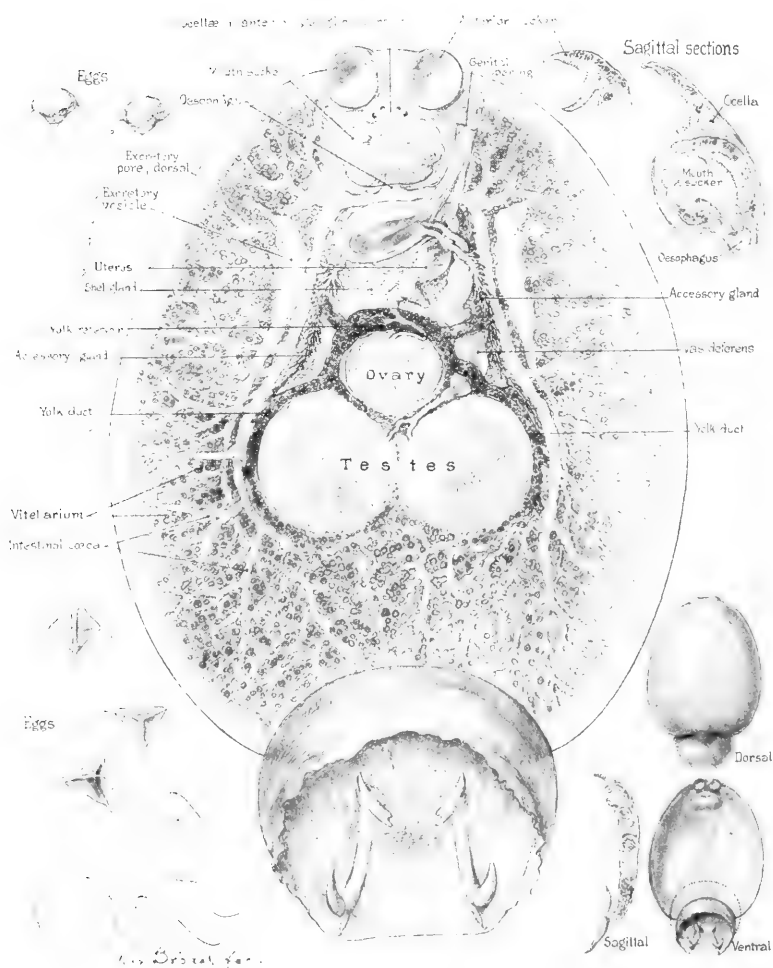
(Fig. 154)

A consignment of spade and angel fishes, was received from the Florida coast waters at the New York Aquarium in the early summer of the year 1926, and in a short time it was observed that the eyes of many were diseased. Miss Ida Mellen, who studied these fishes, discovered that there were parasitic worms which attacked and destroyed the cornea. It appeared that the parasites were introduced into the tanks by a Pacific puffer (*Spheroides annulatus*) which came from southern California, but other fishes such as the spade fish (*Chaetodipterus faber*), and various species of angel fishes (*Angelichthys* and *Pomacanthus*) became infected. The lodgement of the worms is perhaps favored by the fact that the Pacific puffers have eyelids which can be closed over the eyes so that the worms can adhere within the conjunctival sac formed in this way. Several may thus be lodged on each eye of the puffer but not so many on the angel and spade fishes.

They are small, white, smooth trematodes, concave on the under surface and able to adhere strongly by their suckers. The cornea is pierced or eaten through in some way and in about three weeks the eye thus laid open to the exterior is destroyed.

It was found upon study of the worm that it corresponds in a general way with those described under the name *Epibdella* and since it was found by Miss Mellen, the name *Epibdella melleni* is suggested in her honor.

The worms vary greatly in size, some measuring not more than $1\frac{1}{2}$ mm. in length while the largest one found measures 5×3 mm. They are rounded or elliptical in form with a thin flowing margin, the body being arched, convex above and concave below, so that it might seem that the whole body could be employed as a sort of sucker to maintain its hold upon the cornea. Indeed, it seems that this actually takes place although the worm is further supplied with very effective organs of attachment. Posteriorly there is a large flattened sucker attached ventrally, and anteriorly there are two smaller suckers on short stalks arising from the margin of the body, one on each side of the mouth sucker. This mouth sucker lies a short distance behind the anterior margin of the body and is directed ventrally. The genital pore lies on the ventral surface at one side of the mouth sucker a little forward of its center and between it and the stalk of one of the anterior suckers. There are two large testes in the middle of the body and a median ovary. The intestinal coeca ramify into all the marginal part of the body and between them lie the lobules of the vitellarium. So much is made out easily by a survey of the whole worm when

FIG. 154. *L. PIRPILLA MELLENTI* SP. NOV.

All the anatomical details are indicated by the legends on the drawing. The small figures are intended to show: the structure of the anterior suckers and of the mouth sucker; a longitudinal section of the whole body in the median line and finally the concavo-convex form of the body. In one of the last the dorsal excretory pores are shown in exaggerated form.

cleared and mounted, but the exact relations of the internal organs were studied in detail in several complete series of sections, cross, horizontal, and sagittal.

The skin is thin, smooth and unarmed. The anterior suckers which project on short stalk-like prolongations of the marginal body wall are rather funnel-shaped with radiating muscle fibres. Little can be seen of any circular fibres and these suckers seem not very powerful. The portion of the body margin between them is marked off by a slight indentation from that on each side, so that this anterior marginal tissue with the two suckers seems to form a forward projection.

The large posterior sucker is round, shallow and flat and is connected in its centre with the middle of the posterior and ventral part of the body—a great bundle of muscle fibres radiates into the body from the centre of the sucker. Its margins are very thin and can apparently complete the air-tight closure of the sucker on the surface adhered to. In sagittal section one sees cross-sections of arcuate fibres directly under the inside and outside surfaces of the sucker while the bulk of its wall is made up of fibres which stretch from one surface to the other. There are scattered among the muscle fibres a few very large nucleated cells which have a granular protoplasm and are very conspicuous against the pale muscle fibres. There are also ramifying excretory channels more distinctly visible here than anywhere else. The lining of the sucker is quite smooth and there are no papillae. Great chitinous hooks are rooted in the muscular substance near the middle and project into the cavity of the sucker. The form of these as well as that of the spines and hooklets can be seen in the drawing. Two ridges arise about the middle of the sucker and from these there project forward and obliquely outward two short spines which are not recurved—their roots are bifurcated or notched.

The large hooks take root at almost the same places and run nearly straight back—covered with the musculature of the sucker and its lining until nearly the edge of the sucker when they suddenly emerge and turn forward as sharp hooks. From near the points where they bend and turn, there arise two other very small chitinous structures which run still further back quite to the filmy edge of the sucker and end in extremely fine hooks.

It is seen that the spines as well as the points of both sets of hooks are turned forward, so that they must be designed to resist, when embedded in the tissues of the fish, a forward pull by the anterior suckers and probably also by the sucker action of the whole anterior part of the body.

The mouth sucker is large and strong—its inner lining being thrown up into folds. Interspersed among the muscle fibres are many very large deeply stained cells with granular cell body of indefinite outline. The sucker does not open directly upon the ventral surface of the body but lies in a pouch with thin lips, the cuticle being reflected inward and upward on the sucker itself. Even back of this

there are wide spaces in the loose tissue about the rest of the sucker. Its cavity opens directly into the oesophagus which is very short. There is no muscular pharynx. From the short oesophagus there spring the two main lateral intestinal trunks which, however, are so abundantly provided with branching coeca extending into all the marginal parts of the body that the main trunks become almost indistinguishable as such. It appears that they anastomose across the body behind the testes but since they are scarcely visible, except in sections, and there is such a bewildering profusion of branches, it is difficult to be quite sure of this. However, since v. Linstow, van Beneden, and others find this anastomosis in other forms in which the intestine is simpler, it seems justifiable to believe that the continuity traced in serial sections is really true. The intestinal trunks and branches are everywhere lined by rather low, flattened epithelium which is, however, high enough to distinguish these channels in sections from the adjacent excretory channels.

The excretory system consists of widely ramifying channels uniting in longitudinal main trunks. It is extremely difficult to make out the precise course of these channels in sections and they are scarcely to be seen in the cleared specimens of the whole worm except where they form large vesicles on each side anteriorly in front of the level of the ovary. There appear to be two main trunks running back from these just outside the margins of the testes and two running forward to pass in front of the mouth sucker. Posteriorly, between the two main trunks, two others appear and all four run backward to give off abundant ramifications in the large sucker. I can find no median vesicle in this position such as is described by von Linstow in *Phylline hendorfii*. The two large lateral vesicles in front of the ovary open by narrow channels far toward the margin of the body on the *dorsal* surface where they produce minute projecting masses which represent the orifices of the thick-walled tubes.

The nervous system consists of a large crescentic mass in front of the mouth sucker with another ganglionic mass clasped about the short oesophagus. Four black eyelets, or ocellae, are embedded in the anterior mass, the two larger outer ones lying somewhat posteriorly and directed forward and inward, the two anterior ones lying between these and directed backward and outward. They consist of cup-shaped masses of black pigment in the concavity of which is a refractive globule but as they lie embedded in the ganglionic mass far below the skin they must be able at most to perceive differences in intensity of light. They, as well as the general distribution of the nerve trunks, have been minutely described by von Linstow and appear to correspond in this form.

The male genital apparatus is of especial interest in that its structure seems different in some respects from what has been described in other members of the genus. There are two rather large rounded testes lying side by side at about the middle of the body. These give off channels which unite to form a large and rather con-

spicuous vas deferens which is moderately tortuous and runs forward to enter the ejaculatory apparatus without any diverticulum or seminal vesicle. The ejaculatory apparatus consists of a thick-walled, pear-shaped sac which tapers anteriorly to open in a cloacal genital opening on the left side ventrally at about the level of the middle of the mouth sucker and therefore near the stalk of the left anterior sucker. The vas deferens enters it at a point quite distant from its bulbous larger end and indeed quite near the level at which it begins to narrow rapidly to proceed toward the genital opening. But other ducts also enter it, one together with the vas deferens, the other at the large end of the pear-shaped sac. These are the ducts of a peculiar gland which we have not seen before and which is not mentioned by von Linstow, van Beneden and Hesse and others. It is a branching or racemose gland with long, narrow, acinous masses, which lies on each side of the central space in the body which is free of the vitellarium and extends back to about the level of the testes. These elongated lobules are finely granular and take a dull brick red stain in sections stained with haematoxylin and eosin. The ducts are rather thick-walled and are rendered conspicuous by being filled with the brick red stained material. The function of these glands can only be surmised and since it seems only confusing to assume that they are analogous with the human prostate, it would perhaps be better to speak of them as "accessory glands" which will not prejudice any further study of their nature. The ducts are not tortuous but run forward to make an abrupt entry into the ejaculatory sac. This sac has a thick fibrous wall and within it there are two perfectly distinct structures, first the long pear-shaped sacculle which is filled with spermatozoa and receives the vas deferens near its neck after which it is prolonged into the thick-walled penis which is apparently protrusible, and second, another sac folded upon itself and receiving at the two ends of its first part the ducts of the accessory glands while the second part is prolonged into a tube which accompanies the penis to the genital opening but is separate from it almost to its tip. This second sac is filled with a homogeneous hyaline or gelatinous looking material which stains deep pink with eosin and only at the immediate entrance of the ducts of the accessory glands shows any of the reddish granules that they contain. All this complex relation which is very difficult to unravel may be understood better from the drawing. Horizontal sections show that the thin-walled cloaca which is empty as it opens on the ventral surface, is divided a little higher into two parts by a septum—in one is found the penis which at its very tip shows two canals, one containing spermatozoa, the other the hyaline material which comes from the other sac. When the worm is cleared and mounted in toto the two tubes can be clearly seen side by side in the penis to its tip. This is unarmed and tapers to a slightly notched point and in section is seen to have a rather thick homogeneous wall.

The female generative apparatus consists of the round ovary

which is situated in the midline just in front of the testes. It is smaller than either of them. It gives off a short oviduct which arches dorsally to unite with the wide transverse channel from the lateral vitellaria and then passes into the short uterus which runs forward to open in the cloaca side by side with the penis. The uterus in the earlier part of its course is modified by thickening of its wall which is there surrounded by an extensive radiating shell gland. It sometimes contains one egg but in most of the specimens it is found empty. There is no vagina or Laurer's canal, and no receptaculum seminis could be found.

The vitellarium fills up most of the lateral parts of the body from the level of the anterior suckers to that of the beginning of the posterior one. It leaves a narrow margin of the body free and a considerable space in front of the ovary but wide yolk ducts surround the ovary and send branches back round and between the testes.

The eggs are very peculiar in that they are tetrahedral with thick shining bronze colored shell. One of the four angles is rounded and bears no filament, two opposite angles are prolonged into short, clear, chitinous filaments which end in a fine hook or curled termination. The fourth angle is provided with a very long filament as stout as or stouter than the others at first, but tapering to a long thread of extreme thinness which ends without any curve or hook. It is noteworthy that this long filament is perforated throughout much of its length with holes which are variable in size and form; some are narrow, long slits, others round and sometimes so large as to make the margins of the filament project—as the eye of some needles produces a widening of the needle. Sometimes these appear as semicircular bays in the side of the filament but then one can usually see a fine line which arches over them as though they were bubbles in the substance of the filament. The eggs measure 0.12 mm. along each edge of the tetrahedron.

There is a good deal of literature on the subject of various forms closely related to that just described, and some confusion as to the nomenclature. It seems quite clear that the generic names which must be considered are at present *Epibdella*, *Phylline*, and *Phyllonella*, although other names have been used for the same worms, and these names too have been rather indiscriminately applied. In the early days, *Hirudo*, *Caryophyllaeus*, *Nitzschia*, *Capsala*, *Phylline*, *Tristomum* and other generic names were more or less confused. *Phylline* (Abildgaard, 1790), generally referred to Oken (1815), is the generic name still most often confused in its use with *Epibdella*, because it was quickly recognized that the other names such as *Hirudo*, *Nitzschia*, etc., were wrongly applied. *Epibdella* was given by Blainville in 1828. *Phyllonella* is a much more recent suggestion originating with van Beneden and Hesse in 1863 to distinguish those worms which are like *Epibdella* except in that they have a fan-shaped membranous structure in place of the anterior suckers. Van Beneden refuses to recognise the generic name *Benedenia* proposed in his honor by

Diesing in place of *Epibdella*, and accepts *Epibdella* of Blainville in place of *Phylline* of Oken which antedated it, because he thought Blainville knew the worms better than Oken. It is probable, though, that a better reason for accepting *Epibdella* in place of *Phylline* lies in Oken's own description and figures which may be quoted, since the book is rather inaccessible.

"Gattung *Phylline*: Leib glatt, flach, gallertartig, kurz, fast oval. Schwanzscheibe sehr gross. Schmarotzer.

1 Art; *Ph. diodontis*.

2 Art; *Ph. hippoglossi*. Mund nicht zweilippig. Leib länglich, flach, weisslich; in der mitte zwei weisse Flecken. Auf der Haut von *Pleuronectes*. Hierher *Hirudo sturionis* in Kiemen des Störs.

3 Art; *Hirudo grossa*. Mund zweilippig, 1" lang, 1/2" breit; vor der Scheibe, der Afterdarm macht mehrere Windungen. Bauch enthält einige tausende Eier. Ein Geschlechtsloch zur rechten des Bauches. Saugt Muscheln an.

Ph. diodontis. Form des Uhrglases, hinten umgerandet. Kurzer Russel, daneben unten am Leib zwei kleine Napfe. Hinten am Ausschnitt, ein grosser. Saugt sich mittels der Napfe auf den Fische an und saugt durch den Russel ihnen Blut aus. Leib knorpelartig, durchsichtig, gelblich, mit vielen ovalen Flecken. Gegen ein Zoll in allen durchmessern. Hinteren Napf hat sieben Strahlen. Im Leib mehrere Darmwindungen sichtbar, stossen an einem kleinen beinahe viereckigen Behälter. Will es untersinken, so rollt es sich wie eine Hippe auf. Auf einem Diodon der häufig ist von Nootka bis Californien."

From this it is evident that Oken has no definite plan of distinguishing precisely those worms which have since been described as *Epibdella*, and the form to which he directed closest attention under the name *Phylline diodontis*, and which it is perhaps justifiable to regard as his type of *Phylline*, has above all things, seven rays in the posterior sucker. These are shown plainly in his drawing. This is a quite different genus, then, from *Epibdella*, and it seems that *Epibdella*, as applied by Blainville and later more precisely stated by van Beneden and others, should stand.

Of course there are earlier notices of these worms, such as that of O. F. Müller (1776) who describes *Hirudo hippoglossi* as "dilatata, albida, medio corporis oculo didymo, candido," and of Abildgaard who probably used the term *Phylline* as a synonym of *Caryophyllaeus*, but the first clear indications are those given above.

The generic name *Phyllonella* introduced by van Beneden and Hesse (1863) is intended to emphasize the difference in the form of the anterior suckers in different types, for while in *Epibdella* the anterior suckers are rounded and muscular, with true sucker action, they are represented in *Phyllonella* by a membrane-like prolongation of the

body margin with areas or discs differentiated somewhat for adhering. These are not clearly described by anyone, and the species recorded under *Phyllonella* (*hippoglossi*, *sciaenae*) are those already known as *Epibdella*. Nevertheless this distinction should be made, and Monticelli has attempted to separate the forms of *Epibdella* on this basis into two groups;

Phylline, (two "pseudoventose" anteriorly) including *hippoglossi*, *bumpusii*, *soleae*, *diadema*, *squamula*.

Benedenia, (two suckers anteriorly) including *sciaenae*, *hendorffi*, *ovata*, *ishikawae*, *monticelli*.

In principle this has much justification, but it seems that a further study of the whole group is necessary before a decision is reached. Perhaps the distinction suggested by van Beneden and Hesse between *Epibdella* and *Phyllonella* would solve this difficulty and these generic names are more correct historically than *Phylline* and *Benedenia* which Monticelli offers.

The forms described which must be reviewed in order to determine the position of the one now presented, are as follows if we group them under *Epibdella* and *Phyllonella*.

Epibdella sciaenae, *monticelli*, *ishikawae*, *ovata*, *macrocolpa*, *hendorffi*.

Phyllonella hippoglossi, *soleae* [*producta* of von Linstow], *diadema*, *bumpusii*, *squamula*, *steingröverii*.

Epibdella, Blainville,

E. sciaenae, van Beneden, 1856, on *Sciaena aquila*. Round suckers anteriorly; 18–20 × 10–12 mm. Posterior sucker with papillae and peculiar short spine-like hooks. Cirrus sac not double but thin walled and simple. A special gland with orifice near genital pore, recognised later by Goto as vagina. Eggs oval with one long filament.

E. monticelli, Parona and Perugia, 1895, St. Remy, 1898, on gills of *Mugil auratus*, 6 × 2.5 mm., large deep anterior suckers, posterior sucker without papillae, two pairs of hooks, no eyes described, no vagina or eggs mentioned, triangular oesophageal bulb.

E. ishikawae, Goto, 1894, on *Lethrinus*, 4 mm. in length. Round anterior suckers, vagina present. Prostate forms sac attached to cirrus. Hooks in posterior sucker very stout and irregular in outline; no egg described.

E. ovata, Goto, 1894, on *Anthias schlegelii*, 2 mm. long; notches in posterior sucker, 3 pairs of hooks, the posterior ones relatively large and stout, vagina wide and short. Prostatic sac attached to cirrus; no egg described.

E. macrocolpa, Luhe, 1906, on *Rhinoptera javanica*, 9–10 × 5–7 mm. Two definite anterior suckers; posterior sucker with 3 pairs of hooks. Vagina from left margin of genital pore runs back behind testes and then forward to yolk reservoir; vas deferens convoluted; peculiar sacculaton of

mouth sucker; no egg described. Named from long course of vagina.

E. hendorffii, von Linstow, 1889, on *Coryphaena hippurus*, 8.7×5.2 mm. Weak suckers anteriorly; posterior sucker with 3 pairs of hooks. No vagina. Prostatic sac attached to cirrus; receptaculum seminis at origin of uterus. Egg triangular with one filament.

Phyllonella: van Beneden and Hesse.

P. hippoglossi, Müller, 1776, Oken, 1815, van Beneden, 1858, etc. on *Pleuronectes hippoglossus*, *Hippoglossus vulgaris*, etc., 24×10 –13 mm. Posterior sucker lined with papillae; prostatic sac attached to cirrus; vagina present.

P. soleae, van Beneden and Hesse, 1863 (*E. producta*, von Linstow) on *Solea vulgaris*, 6–7 mm. long with anterior membrane of fan shape; body covered with papillae. Posterior sucker separate from body on stalk, 4 curved hooks. Eggs oval, truncated with one nodose filament. von Linstow also figures two more minute hooks in the posterior sucker.

P. diadema, Monticelli, 1902, on *Trygon violacea*, 7×2.5 mm. Vagina opens separately, eggs not described. Anterior suckers represented by elongated sessile, adhering patches (pseudoventose).

P. bumpusii, Linton, 1900, on *Dasyatis centrura*, 12.5×8.3 mm. Anterior suckers are false suckers, flattened and sessile. Cirrus, uterus and vagina open together. Eggs tetrahedral with one long slender filament. Vagina dilated anteriorly to form receptaculum seminis. Four hooks in posterior sucker.

P. squamula, Heath, 1902, on *Paralichthys californicus* and *Sebastes*, 3.5×1.5 – 18×10 mm., size proportional to size of host. There is a prostatic sac attached to the cirrus with ducts running to cells in the vicinity of the testes. Eyes move rapidly. Vagina tortuous, seminal reservoir at origin of uterus. Eggs bluntly triangular with one long filament.

P. steingröveri, Cohn, 1916, host unknown (south-west African fish?), 9×5.3 mm. papillae in posterior sucker, adhering discs anteriorly instead of suckers, 3 pairs of hooks in posterior sucker. Vagina present opening near that of uterus and cirrus.

The present form, *Epibdella melleni* differs from all those described in important respects, especially in regard to the structure of the generative apparatus and the form of the egg. Most careful examination of several complete series of sections in all directions has failed to reveal a vagina in *E. melleni*, although the rest of the female genital tract can be traced in exactly the same course in each individual.

It is therefore proposed to describe *Epibdella melleni* as a new species with the following summary of its characters;

Family TRISTOMIDAE, Taschenberg,

Subfamily, TRISTOMINAE, Monticelli,

Genus *Epibdella*, Blainville.

***Epibdella melleni*, sp. nov.**

Ectoparasitic trematode on the eyes of *Spheroides annulatus*, *Chaetodipterus faber*, *Angelichthys isabelita*, *Pomacanthus arcuatus*, etc.

Body oval, measuring $2.5 \times 1.5-3$ mm., with definite anterior suckers; skin smooth, posterior sucker with two pairs of hooks and two spines, no papillae. Digestive tract abundantly branched. Ejaculatory apparatus with two sacculs within the outer capsule, one receiving the vas deferens, the other the ducts of branched accessory glands and opening together through the penis. No vagina. No receptaculum seminis. Eggs tetrahedral, with two short hooked prolongations and one long thread-like filament.

The literature on all these forms is sufficiently recorded in the Index Catalogue of Medical and Veterinary Zoölogy, Stiles and Hassall. The only new work, found through the kindness of Dr. Hassall and other members of the staff of the Bureau of Animal Industries in Washington, who put their card catalogues at our disposal, was

Luhe; Report on Trematode Parasites of Marine Fishes; Report by the Royal Society, 1906, to the Government of Ceylon on Pearl Fisheries.

Cohn; Zeitschr. f. wiss. Zool. 1916, CXV, 460.

Mr. Max Brödel was kind enough to make the drawings and my son, Dr. W. G. MacCallum helped me with the paper.

ZOOPATHOLOGICA

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THE TREATMENT OF FISH DISEASES

BY IDA MELLE

Staff of the New York Aquarium

Fifty-seven institutions and individuals were circularized during 1927, in an effort to gather data for the present paper from everyone in the world who had experimented with the diseases of fishes. The thirty-nine other public aquariums were among these. Eight aquariums replied that either no work had been done, or no records had been kept, or there were no results to report. Only seven replied with records of experiments.

Mr. F. A. Potter, Director of the Honolulu Aquarium, reported, "When they get to looking 'seedy,' we cast them out and get healthy specimens." Mr. M. R. Johnston, Director of the Blackpool Aquarium, Blackpool, England, says: "In the treatment of diseases of fresh-water fishes we use a solution of permanganate of potassium, 1 in 60, one day immersion; but the great factor with our fish life is the daily direct supply of sea water from the sea. We have been entirely free from any disease in our salt water fishes."

From the aquarium at Monaco we have the following general remarks of interest, in addition to specific records: "New specimens, both vertebrate and invertebrate, are segregated for a few weeks in reserve tanks with good aeration and continuous circulation. Fifty per cent. are lost of some species, such as *Maeon vulgaris*. Once acclimatized, they live for from two to sixteen years in public tanks. In specimens thus acclimatized, sickness is rare."

Besides special data, Don Carlos Moreira, Director of the two aquariums in Rio de Janeiro, says: "The fishes in the fry time suffer and die by the impossibility to spawn, but this is not common. The salt water fishes are not much subject to disease. They suffer and sometimes die of the fry time troubles and skin diseases produced by alimentary cause and consecutive intestinal infection for which has been found no successful curative means when the infection is not slight."

The following persons supplied reports of definite experiments:

- Mr. Wallace Adams, Steinhart Aquarium, San Francisco, Calif.;
- Dr. R. V. Bangham, Biology Department, Wooster College, Wooster, Ohio;
- Mr. E. K. Bruce, Bruce Goldfish Fisheries, Thornburg, Iowa;
- Dr. H. S. Davis, Pathologist, U. S. Bureau of Fisheries, Washington, D. C.;
- Dr. G. C. Embury, Cornell University, Ithaca, N. Y.;
- Mr. Fred J. Foster, Westover Fisheries Co., Steelville, Mo.;
- Dr. John E. Guberlet, University of Washington, Seattle, Wash.;
- Mr. Chas. O. Hayford, Supt., State Fish Hatchery, Hackettstown, N. J.;
- Dr. Emmeline Moore, Investigator in Fish Culture, State Conservation Department, Albany, N. Y.;
- Mr. Harry P. Peters, (Breeder of Fancy Goldfishes) Philadelphia, Pa.;
- Mr. Herbert F. Prytherch, Biologist, U. S. Bureau of Fisheries, Washington, D. C.;
- Dr. Chas. Wardell Stiles, U. S. Public Health Service, Washington, D. C.

The following public aquarium heads sent data:

Mr. William J. O'Brien, Director, Boston Aquarium, Boston, Mass.;
 Mr. Walter H. Chute, Associate Director, Shedd Aquarium, Chicago, Ill.;
 Mr. Alvin Seale, Manager, Steinhart Aquarium, San Francisco, Calif.;
 Don Carlos Moreira, Director of the two Aquariums at Rio de Janeiro, Brazil;
 Mr. E. G. Boulenger, Director, London Aquarium, London, England;
 Dr. R. Dida, Director, Nice Aquarium, Nice, France;
 Dr. M. Oxner, Assistant Director, Monaco Aquarium, Monaco.
 Mr. L. G. Harron, Supt. Aquarium, U. S. Bureau of Fisheries, Washington, D. C.

Incorporated herein also are the experiments made by the author at the New York Aquarium, by Dr. Bruno Hofer as they appear in the limited translations of his works,* and by others which are quoted from their printed papers. These are as follows:

Mr. F. V. Gillis, Amateur Aquarist and Reptilian Review, London, Winter number 1926;

Mr. William T. Innes, Goldfish Varieties and Tropical Aquarium Fishes, 1927;
 Mr. William E. Meehan, Fish Culture in Ponds and Other Inland Waters, 1913;
 Mr. Albert E. Parr, New York Zool. Socy. Bulletin, May-June, 1927;
 Mark Samuel, The Amateur Aquarist, 1894;
 Herman T. Wolf, Goldfish Breeds and Other Aquarium Fishes, 1908;
 Dr. Wilhelm Roth, Diseases of Aquarium Fish, 1922.

Dr. Roth's book is in German, and Dr. David L. Belding of the Boston University School of Medicine very kindly supplied a translation of Section IV., Medical Treatment of Fish Diseases.

Mr. E. L. Wickliff, Assistant Chief, State Division of Fish and Game, Columbus, Ohio, has been very helpful in supplying names of persons working with fish diseases. He worked with Dr. Bangham on some of the experiments herein recorded.

There are tabulated herein 166 experiments, made by 30 persons, with 47 successful chemicals and other remedies. The paper is the first of its kind and we hope it will serve as a foundation for much future work with sick fishes.

Dr. Henry Winsor, of Haverford, Pennsylvania, who has studied the diseases of fishes, says: "Nine times of ten I do not know what killed the fish, even after doing a post mortem."

He found it possible to transfer fish tuberculosis (*B. tubercle piscium*) from salt to fresh-water species, though not to transfer human tuberculosis to fishes. Some other experimenter succeeded in infecting guinea pigs with bacilli from tuberculous carp. It is said that only one fish parasite is transmissible to human beings, a tapeworm, *Diphylllobothrium latum*, which would, of course, be killed by proper cooking.

Dr. Winsor offered the following valuable suggestion: "I am beginning to believe that those bacteria which cause decomposition after death may be the very ones which are beginning to cause decomposition in parts of the body or even most of the body before death

* See Dr. Emmeline Moore's translation, 12th Annual Report, N. Y. State Forest, Fish and Game Commission.

takes place. In other words, the saprogenic bacteria, the germs of decay formed after death in most bodies, might become pathogenic, causing fatal disease in living bodies. Some sort of vacuum cleaner should be invented for use on the bottom of tanks and aquaria, so that the sediment could be removed without stirring it through the water. This would prevent the accumulation of the saprogenic or decay bacteria, which poison the water."

As a matter of fact, such a vacuum cleaner was devised several years ago by Mr. Otto Gneiding, breeder of fancy gold and tropical fishes at Ridgefield Park, N. J., at whose hatchery the author saw it in use. The suction base was about four inches in width and the cleaner worked satisfactorily. Mr. Gneiding reports that he is still using this vacuum cleaner, and says "I have also bought a regular one, with bristles on each side, and find it works fine." At public aquariums a hose is used, but a large vacuum cleaner would doubtless be more efficacious for the removal of uneaten food, slime, excreta and sediment.

In 1926, Mr. Robert J. Lanier then of the Steinhart Aquarium, conveyed single-handed from New York to San Francisco, a shipment of over one hundred fresh- and salt water fishes, and arrived with all alive but eight. He attributed his success to constant filtering of the water through heavy white felt. The bottom of the containers was wholly free from slime and dirt and the water in them crystal clear at the end of the journey. The fishes did so well that many of them still are living. Some of the salt water kinds had traveled by boat from Florida to New York before journeying by rail from New York to San Francisco.

Too much cannot be said about the need for cleanliness as a preventive measure against disease. There is much room for improvement in methods of handling live fishes, not only in the matter of cleanliness, but with respect to wounds and bruises which often might be avoided.

Everyone who has worked with sick fishes knows that the first necessary steps in all medical work with fishes are the segregation of sick specimens, since most of their diseases are communicable, the complete disinfection of nets, tanks and pools, and the careful destruction of incurable and dead specimens.

In my own experiments, I have reached the following general conclusions:

If a fish is well, it cannot endure strong medicine.

If a fish is in a dying condition, strong medicines will instantly kill it.

If a fish is very sick but not dying, it can stand powerful doses and will show improvement after the first treatment if the medicine is correct.

When convalescence has begun in a fish extremely weak from recent illness and refusal of food, handling is dangerous and may result in hemorrhage of the gills and immediate death. A clean,

quiet, shaded tank and live food to coax the lost appetite, may save a very weak specimen where handling and treating are fatal.

In destroying trematodes and argulids, it will be found that a solution which kills them quickly under the microscope will not kill as quickly when they are attached to the fish. If a solution kills the free parasite in fifteen seconds, it is well to immerse the fish in it for from three to five minutes, according to its resistance.

In handling fishes, it is important to remember that their eyes have no lids and are liable to injury and infection from the pressure of the net or the touch of a hand. The meshes of the nets should be smaller than the eye of the fish, and when treating fishes for injured eyes, only nets of soft cloth are suitable. Moreover, the sides of the tank should be lined loosely with burlap or other cloth to prevent temporarily blinded eyes from coming into contact with concrete or metal and so becoming permanently blind. The type of net at present manufactured, with numerous hard knots, is well suited to rip off the scales, tear the fins, and injure the eyes of fishes, and not suited to handling specimens which it is desired to maintain in a state of health. The ideal net probably would be one made of strong but soft, unknotted netting, similar to that used for window draperies.

A point easy to miss is individual need. Fishes differ in resistance and response not only specifically but individually, as people do.

Mud baths, so efficacious for many species of fresh-water fishes, are not suitable for salmonidae, which do best where there is a sandy or gravelly bottom, though old hard-packed mud bottoms have in some cases proved advantageous.

If fishes are bruised, it goes far harder with them than if they are cut. Rought treatment that would break the bones of a mammal, will break no bones in a fish, but it will send bruises so deep into the tissues and muscles that there is no chance for recovery. We have had an opportunity to observe this at the New York Aquarium in the case of fishes of large size brought from the middle west to be sold alive in eastern markets. The majority of such specimens secured from live fish dealers for our exhibition tanks were bruised beyond repair.

Our pure salt water at the New York Aquarium is maintained in a closed system and we have about as much sickness among salt water fishes as among fresh. There is a general supposition that inasmuch as fresh-water fishes are put into salt water to revive them and kill their parasites, fresh water, used for salt water fishes, should serve the same purpose. Personally, I have had no success in the use of fresh water for ocean fishes. Until recent years, no remedies were known for salt water fishes, and salt and permanganate of potassium were the only medicines used for fresh-water kinds. The present paper, recording 47 successful remedies, shows the progress that experimenters are making. Many persons, however, have studied the diseases of fishes with respect to their causes, but hav

not entered upon experiments with relation to cures. In the course of time their findings will be immensely valuable in diagnosing and working out remedies for fish diseases. In public aquariums prompt action is necessary, and a certain terse expression of Gina Lombroso's makes a good motto: "To help living life it is better to guess quickly than to carry out minute investigations." On the other hand, five minutes with the microscope often eliminates the need for guessing.

Bloating is a common occurrence among sick fishes. There appear to be five troubles which cause a fish to bloat: gas, dropsy, egg-binding, bacterial infection in the alimentary canal, and tumor (or, rarely, cancer). If the fish when tapped for dropsy, exudes no water, and does not respond to treatments for gas, egg-binding and bacterial infection, the case may be tumor. I have diagnosed but not treated one such case. The specimen was a beautiful white fantail goldfish. It lived for about two years after bloating began (a much longer time than it could have survived with any of the other bloat diseases), ate well, and enjoyed long periods free from pain. At one time it appeared to suffer, and its owner, a clergyman, threw it out into the snow to help end its misery. Four hours later he chanced to look out and was astonished to see the fish still flopping. He decided to give it another chance and returned it to the aquarium where it lived for more than a year, not suffering again until a few weeks before death. Autopsy revealed the presence of two tumors.

We have records of cancer in the salmonidae, it has been known to occur also in toy tropical fishes, and Dr. M. Nishibe of Tokyo, Japan, informs me that cancer has been found in goldfishes.

Chemicals recommended for sterilization of tanks and ponds after infectious diseases are as follows:

Permanganate of potassium, strong solution.

Salt, strong solution.

Bichloride of mercury.

Copper sulphate.

Unslacked lime.

Formalin.

It may not be out of place here to add a few words relative to medical work with aquatic animals other than fishes.

The Aquarium at Monaco expects to publish a voluminous paper covering its successful experiments with a malady affecting the majority of its invertebrates and which it attributes to "putrefaction microbes."

The author, in working with amphibians and reptiles at the New York Aquarium, has found these animals easily treated for bruises and fungus. Kerosene oil, swabbed onto a bruised and fungused alligator or salamander will work wonders. In the case of skin diseases, a two percent. solution of mercurochrome applied with a soft brush several times at intervals of a few days, will generally effect a cure. Salamanders should be given a mud bath after treatment, until fully recovered.

Turtles are commonly afflicted with tumors, which are of two kinds: hard, embedded in the dermis, and soft, growing in the tissues. Hard tumors can be cut out with a sharply pointed scissors and the wound dusted with xeroform* immediately after the operation and on one or two successive days. Soft tumors should be treated by bathing with hot water, drying and applying iodine. This should be done daily for three days, with a rest for three days, then resumption for three days, and so on. The tumors will soften, diminish, and finally drop off.

For eye trouble in turtles, nothing is better than boracic acid slightly heated and used as for the human eye. In case of swelling of eyelids, collyrium may be used instead.

To build up sick reptiles and amphibians and keep them in health in captivity, live fish or whole fresh fish should be fed, to provide gland secretions and lime. Fish ground with the bone in it can be substituted if necessary. My paper on "The Natural and Artificial Foods of Fishes," American Fisheries Society *Transactions* for 1927, covers the question of the proper feeding of captive fishes.

DISEASES AS ARRANGED IN THE FOLLOWING TABLES

Achlya. See Fungus.

Anthropophobia

Asphyxia

Bacterial Diseases:

Bacillus columnaris

B. tubercle piscium

Bacterial, causing Fin Disease, Nipped Fin, Tail Rot

Bacterium cyprinicida, causing Pond Disease, Red Plague

B. salmonicida, causing Furunculosis, Ulcer Disease

B. truttae

Bruises. (See also Wounds.)

Colds

Constipation. See Indigestion.

Crustacean Parasites:

Anilocre

Argulids

Cuts. See Wounds.

Dropsy

Egg-binding

Eye troubles:

Exophthalmic goitre

Injured eyes

Pop eye

Fin Disease or Nipped Fin. See Bacterial, Flukes.

Flukes:

Ancyrocephalus

Epibdella

Gyrodactylus

Microcotyle

Fungus Disease:

Achlya

Saprolegnia

For Black Fungus see Protozoan Parasites.

* Xeroform is Tribromphenol-bismuth "Heyden," manufactured by The Heyden Chemical Works, Garfield, N. J.

Furunculosis. See *Bacterium Salmonicida*.

Gas

Gas-bubble Disease. (See also Eye troubles - Pop eye.)

Gill Diseases. See Bacterial Diseases, Flukes, Colds, Protozoan Parasites -
Octomitus.

Indigestion

Leeches

Nervous Shock. See Anthropophobia.

Pond Disease. See *Bacterium Cyprinicida*.

Protozoan Parasites:

Black Fungus

Chilodon

Costia

Cyclochaeta

Ichthyophthirius

Myxosporidia*

Octomitus

Sporozoan

Red Plague. See *Bacterium cyprinicida*.

Roe binding. See Egg-binding.

Saprolegnia. See Fungus.

Skin Diseases

Swim Bladder Trouble

Tail Rot. See Bacterial Diseases.

Trematodes. See Flukes.

Ulcers. See *Bacterium salmonicida*.

Whirling Sickness. See Protozoan Parasites -*Octomitus*.

Wounds and Cuts.

* To identify Myxosporidia, see "On the Classification of the Myxosporidia, a Group of Protozoan Parasites Infecting Fishes," by R. R. Gurley, Bull. U. S. Fish Commission, 1891.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Andropophobia* (Nervous Shocks)	Fainting. Fish lies on back, gasping, when over a person approaches tank.	Shoerper (<i>Phenotia maculatus</i>).	Thickly planted tank. Keep fish with others of its kind. Disturb tank as little as possible and feed in regular way three times a week. Approach tank, quietly.		Old remedy. New York Aquarium.	Cure.
"	"	Fresh-water fishes in general.	Darkness, fasting and sour milk.	Keep fish in darkness 48 hours, fasting. Then feed sour milk.	Old remedy.	"
"	Fish shakes and darts as though being eaten alive, yet has no parasites.	Barbel (<i>Barbus semitis choldus</i>).	Sea water and mild baths, darkness, fasting.	Dip fish in strong salt solution or pure sea water, 10 seconds or longer, according to resistance, then in dark, muddy tank for 1 week without food. Then place in thickly planted tank and feed regularly.	Mellen.	Fish quieted down in 2 1/2 weeks.
"	Exhaustion and debility.	Goldfishes (<i>Carassius auratus</i>).	Rest, darkness, fast salt bath.	Complete rest in darkened tank and a few days' abstinence from food in an epsom salt solution, 1 tea-spoonful to gallon water.	Wolf.	Cure.
Asphyxia.	Gasping and distress from being too long without fresh oxygen.	"	Oxygenated water.	Put fish in well aerated water and add a few drops of oxygenated water.	Dika.	Good.
"	Inflamed gills caused by poisonous gases or sudden changes of temperature in the water.	Goldfishes and fresh-water fishes in general.	Salt.	Give salt bath, using crushed rock salt.	Meehan.	Generally efficacious.
"	Same symptoms, also sore throat.	Fancy goldfishes (<i>Carassius auratus</i>).	Salt baths, rest, increased aeration, nourishing food.	Inject gills with salt water at repeated intervals. Put fish in shaded, well planted, quiet tank, with nourishing food. Aerate water with fountain syringe or by using a constant drip.	Wolf.	Many fine specimens saved.

* This ingenious name was suggested by Dr. M. Nishibe of Tokyo, meaning "fear of man."

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Bacterial diseases; by over-crowding and pollution) <i>Bacillus columnaris</i> , (Rod-shaped, motile, having flagella.)						
	Yellowish areas with dark blue centers on caudal fin and gills, later on body and growing larger. Followed by <i>Suppuration</i> . Develops quicker in temperature above 75° F. Fish dies in 24 to 74 hours.	Buttaloish (<i>L. triobus</i>)	Potassium permanganate, 1:50,000.	Immerse fish 10 to 15 min.*	Davis.	Cure.
		Basses (<i>Micropterus</i>).	Potassium permanganate, 1:20,000.	Immerse fish 10 to 15 min.	Davis.	Cure.
		Buttaloish (<i>L. triobus</i>).	Copper sulphate, 1:25,000.	Immerse 20 min. before lesions; well fishes less time. Remove at once to running water. Repeat 2 or 3 times at 12-24 hour intervals. Wood, paraffined, or painted galvanized vessels best.	Davis.	Largely effective.
		Basses (<i>Micropterus</i>) and Bullheads (<i>Ambloplites nebulosus</i>).	Copper sulphate, 1:20,000.	Do.	Davis.	Largely effective.
		Blackfish (<i>Orthodon microlepidotus</i>).	Copper sulphate, 1:1,000.	Immerse for 2 min.	Scale.	Cured.
		Fresh-water fishes in general.	Copper sulphate.	solute fish. Give bath 20 min. in sol. 1:30,000; or 2 min. in sol. 1:1,000; or swab ulcer with 1% solution, then dip in 1:1,000 for 1 min. Transfer to running water. Repeat in a few days.	Scale.	Cured.

* min. is an abbreviation of minute.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
<i>B. tubercle piscium.</i>	Emaciated body, sunk-in eyes, listlessness, loss of appetite.	(Goldfishes (<i>Carassius auratus</i>).	Green water, mud, or salt bath.	Place fish in ample supply of green water, or in shallow, muddy pond or tank, or in salt bath ($\frac{1}{2}$ oz. sea salt to gallon water). Feed daphnia, oyster, earthworm.	Innes.	Beneficial.
		(Goldfishes (<i>Carassius auratus</i>).	Salt baths, milk, lime foods.	Put fish in milk 15 min., 3 days a week. Rinse off in strong salt solution. Feed raw fish with bone ground in sour milk, junket, chicken liver, boiled oatmeal, egg-yolk and spinach. Live foods whenever possible.	Mollen.	2 specimens were apparently recovering, but attendant overlooked them while in milk bath, and 35 min. immersion killed them.
Bacterial ?	Gills affected.	Trout.	Copper sulphate.	Dip fish in solution 1-2,000 for 1 min. Remove quickly to running water. Repeat next day.	Davis.	Cure.
Bacterial ?	Large white spots on sides, swollen. Scales drop off, exposing dermis with pits eaten deep into tissues.	Blue angelfish (<i>Pomacanthus isabellii</i>).	2% mercurochrome and Turlington's balsam.	Apply mercurochrome 2 or 3 times at intervals of 3 days until spots clear. Then dry and paint once or twice with Turlington's balsam.	Mollen.	Healed well. Cured.
Bacterial ?	Fish floats from head to tail so that gills appear indented. Next loses appetite and activity. Finally inflamed areas appear on body and death follows. Dissection shows only clogging of alimentary tract with milky, gelatinous substance.	(Goldfish (<i>Carassius auratus</i>).	Epsom salts, 4 table-spoons to gallon water.	Drop fish into solution every day as long as it will stand it, from one hour the first day to six hours the third or fourth.	Mollen.	Swelling subsided noticeably each day until gone in a few days.
			(Castor oil, used as for indigestion, on two successive days, of no avail.)			

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Bacterial ? (Fin Disease, Nipped Fin).	Fins disintegrate.	?	Potassium permanganate 1-50,000.	10-15 min. bath.	Moore.	Cure.
"	"	?	Copper sulphate 1-2,000 (Davis formula).	1 min. dip.	Moore.	Cure.
"	Inflamed and bloody streaks in fins and tail. (Caused by excitement, im-pure water, overfeeding, bladder trouble.)	Goldfish.	Repeated laxatives, peroxide. Improved aeration.	Drop castor oil down throat, frequently dip body and fins in dilute peroxide of hydrogen. Better aeration alone may effect a cure.	Wohl.	Effective temporarily.
Bacterial (Tail rot).	Blood streaks appear in tail, a thin white line along edges. Tail frays, becomes stringy and rots away.	Goldfish.	Salt and blue vitriol 1-1,000.	Use wooden receptacle never metal for blue vitriol. Dip fishes first in salt solution to loosen slime, then 1 min. in blue vitriol.	Bruce.	Very efficacious.
"	"	"	Coal oil or turpentine. Phenol sodique. Surgery.	Dip tail once a day for several days in coal oil or turpentine, following with dip in phenol sodique. Then cut away affected parts with scissors.	Meehan.	Destroys germs.
"	"	"	Turpentine and 50% peroxide.	Dip from gills back in turpentine and then in 50% peroxide. Repeat in a week or 10 days if necessary.	Mellen.	100% cured very severe cases.
"	"	"	Fused oil, 30 drops to quart of water.	Place in solution 3 seconds.	Peters.	Cured.
"	"	"	Bichloride of mercury, 1 tablet to pint of water.	Dip tail, being careful to protect gills.	Wohl.	Effective.
"	"	"	First try remedy for fin disease. Nitric acid.	If not effective, use nitric acid to cauterize, as a last resort, protecting gills.	Wohl.	Effective.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Bacterial ?	Body ulcers.	Golden trout (<i>Salmo gairdneri</i>), <i>Salmo aquilonia</i> .	Peroxide of hydrogen and iodine.	Wash with peroxide and then with iodine.	Seale.	Cured.
<i>Bacterium cyprinella</i> (Pond Disease, Red Plague).	Red skin on sides and belly. Languid. Rises to surface and lies on side. Death without suffering in 5 to 20 days.	Carp-like fishes: tench, carp, etc.	Transfer to clean, swiftly flowing water.		Hofer.	Cures sometimes, (cleanliness the only preventative.)
<i>B. salmonella</i> (Furunculosis, Ulcer Disease).	Attacks every organ from intestines outward. Contagious. Death in 2 or 3 weeks.	American brook trout (<i>Salvelinus fontinalis</i>).	Place fish in rapid current of cold water.		Hofer.	Will cure a light attack.
"	Abscesses size of a pea. Fish becomes sluggish and weak in 8 to 14 days.	Lochleven trout (<i>Salmo leuciscus</i>), Brook trout (<i>Salvelinus fontinalis</i>), Brown trout (<i>Salmo trutta</i>), Jarrow.	One part 99% glacial acetic acid to 500 parts water. For specimens under 4" long, 1 part to 500 750.	Immerse 30 to 40 seconds.	Hayford.	
<i>B. trutta</i>	Body ulcers.	Golden Trout of Mt. Whitney (<i>Salmo gairdneri</i>), <i>Salmo aquilonia</i> .	Salt and epsom salt, 2 tablespoons salt and 1 tablespoon epsom to gallon.	Immerse fish and have a small spray of fresh water run into tank over night; 3 treatments.	Seale.	Cleaned up fish with a death of 6 out of 11 large specimens.
"	"	Lochleven trout (<i>Salmo leuciscus</i>).	Iodine, epsom salt and salt.	Apply iodine to ulcers. Then weak solution epsom salt and salt. 3 days.	Seale.	Benefitted.
Brüises.	Scales sometimes torn off, fish lies quietly on bottom of tank, or floats weakly at top.	Jewfish (<i>Pseudoscaphium latius</i>).	Silver Nitrate.	Swabbed on affected part.	O'Brien.	Effective in light cases.
"	"	Goldfishes (<i>Carassius auratus</i>).	Kerosene oil and aluminum sulphate.	Drop fishes in oil 1 min. to 3 min., according to individual resistance. One week later give bath in solution of aluminum sulphate, 1 oz. to gallon of water.	Mellen.	Effective in light cases.

* Dr. Belding calls this disease "Fish septicemia furunculosis" and states that it is characterized in some cases by a diffuse peritonitis. The local lesions consist of hard or soft tumors situated in the muscles just beneath the skin, and all species of fishes can be infected artificially. Out of 40 species tested, Dr. Belding finds that the eel is most resistant and the mackerel least. Reduction of temperature, antiseptics, dyes, mud baths, increased flow of water, vaccine and antiserum treatments failed to cure, although more rapid flow of water increased the fishes' general resistance and a short bath in basic fuchsin seemed to give a slightly better resistance to progress of the disease after artificial inoculation.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Colds (Gill Disease) (Gill Congestion).	Dull appearance of skin with milky areas sometimes resembling an incipient attack of Saprolegnia.	Carp (<i>Cyprinus carpio</i>). Tench (<i>Tinca</i>). Goldfishes (<i>Carassius auratus</i>). <i>Subimperi</i> .	Transfer to warmer water.		Hofer.	Fish throws off dead epidermis and regener- ates new, often re-covering in a few days. If cold attacks cuts, the fish generally dies.
"	"	Goldfish (<i>Carassius auratus</i>).	Salt baths, 3 1/2 oz. salt to gallon water.	Place fish in bath until it turns over. Then transfer to running water, repeating daily until improved.	Times	Cure.
"	Fish hides among plants; colors fade; appetite sluggish.	Fancy goldfishes.	Sweet spirits of nitre, ammonia, salt baths. Increased swimming space, richer foods.	Place fish in bath in larger quarters, using 1 teaspoon salt (half epsom) and 8 drops each of household ammonia and sweet spirits of nitre to gal- lon of water. Change bath every 24 hours. Feed raw meat, liver, mussel, and live pond snails and crustaceans.	Mellen.	Cured in a few days.
"	Dull appearance with whitish areas. Fish sluggish, refused food.	Lungfish (<i>Lepidosiren paraguayana</i>).	Pure warmed sea water bath, followed by warmer fresh water.	Lower fish in net into sea water 80° keeping head above water. Immerse body for 5 min., dip head twice. Raise temperature of water in fresh-water quarters. Repeat sea bath in a week or 10 days if necessary.	Mellen.	Fish at once lost milky patches, became lively, ate well. Liv- ing yet, some months later.
"	"	?	Potassium permanganate slim, 1/50,000.	Potassium permanganate of potas- sium, 1/50,000.	Moore.	Cure.
"	"	?	Copper sulphate 1/2,000 (Davis formula).	Copper sulphate 1/2,000 1 min. dip.	Moore.	Cure.
"	"	Top minnow (<i>Zygon- es dasypterus</i>).	Mercuriochrome 100 cc. of 2% solution plus 50 gallons water.	Mercuriochrome 100 cc. of 2% solution plus 50 gallons water.	Seale.	Cured.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Crustacean parasites: T. Amblocre	Attached to mouth and tongue.	Mourmies (<i>Paed mon-myrius</i>).	Only remedy is to remove fish on exhibition.		Dida.	
Acanthids	Attached to scales.	Goldfish (<i>Carassius auratus</i>).	Turpentine and kerosene.	Touch the argulid with this solution and it will drop off.	Innes.	Cure.
"	Visible parasites. In an aquarium they lay eggs on glass in long, even strings, like a train of cars.	Long-nosed Gar (<i>Leptodosteus osseus</i>).	Mercurochrome.	Immerse fish in strong solution, 5 hours, maintaining aeration if possible.	Mellen.	Fish came out dyed red and waving scarlet fins. Color restored over night and fish in excellent condition. All parasites killed.
Dropsy. (Incurable disease of the liver, accompanied by diabetes. When cure is found for human beings, we may know what to do for the fish.)	Heavily bloated body; distended scales. Pressure or piercing causes exudation of water. Generally kills in four months.	Goldfishes (<i>Carassius auratus</i>).	Starvation.	Starvation for several weeks has effected improvement.	Innes.	No cure.
"	"	Fresh-water fishes.	Digitalis.	5 to 10 drops to gallon water in shallow aquarium, makes fish more comfortable.	Samuel.	No cure.
"	"	Fancy goldfishes.	Tapping.	Insert hypodermic needle on each side from below, upward and outward, just under the skin, two or three times a year.	Wolf.	No cure, but valuable specimens have been kept alive for years in this way.
Egg-binding. (Caused in open waters by pollution and other poor spawning conditions, and in captivity by unnatural environment.)	Loss of appetite and bloated condition due to gas from decaying eggs.	Salt and fresh-water species.	Stripping according to approved methods.	Insert small forceps, rose stick or pen handle in vent, according to size of fish, parallel with body. Gently press from pectoral fins toward vent. Eggs will flow out. If swelling and loss of appetite continue, repeat in a week or so. When all eggs are gone, fish will resume feeding.	Old remedy.	Sure cure.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Eye troubles; Exophthalmic goitre.	Develops slowly, a gaseous or effervescent goitre; eye finally bursts.	<i>Pagellus</i> , 5 sp., <i>Mullus barbatus</i> , <i>Callinectes griseus</i> .	Enucleation the only remedy.	Press out eye with finger.	Oxner.	Cured and surviving a number of years.
Injured eyes	Sight temporarily destroyed by injury.	Telescope goldfishes (<i>Carassius auratus</i>).	Boric acid. Or a solution nine parts glycerine and one part iodine.	Swab with absorbent linen cotton soaked with boric acid. Or swab with glycerine and iodine, one treatment sufficient.	Imms.	Clears up in weeks.
"	"	Fresh-water fishes.	Collyrium.	Drop gently on eye, 3 days in succession.	Mellen.	Cure.
"	"	Salt water fishes.	Silvol 10% solution.*	Drop gently on eye 3 days in succession.	Mellen.	Cure.
"	Abnormal protrusion of eye, opaque cornea.	Telescope goldfish.	Isolation, boric acid. Prompt treatment.	Wash eye with pledget of cotton dipped in boric acid once a day until benefited. Isolate fish and feed by hand if necessary.	Woh.	Always danger of permanent injury. This treatment will cure in one month if fish is vigorous.
Pop eye.	Bubbles form around eye, then eye protrudes if not taken care of.	Chinook Salmon (<i>Oncorhynchus tshawytscha</i>).	Piercing and silvol, 10%.	Pierce bubbles carefully with small, sharp embroidery scissors. Then place fish in solution of silvol for 3 min. Feed live food, maggots if procurable.	Mellen.	Perfect cure. Fish lived a long time.
"	"	Fresh-water species.	Warmer temperature.	Transfer to warmer water which contains more nitrogen. Put fishes affected in running water, into balanced aquaria.	Old remedy.	Cure.
"	Milky appearance of cornea, caused by presence of lobster (Homarus vulgaris) in same tank.	<i>Conger vulgaris</i> , <i>Pagellus</i> , 5 sp., <i>Labridae</i> , <i>Scarpaenidae</i> , <i>Gobiidae</i> , <i>Bleniidae</i> , <i>Serranus scriba</i> , <i>S. cetratus</i> .	Permanganate of potassium unavailing. Only Oxner. remedy is to remove first sick fish, as the trouble is epidemic, and sterilize tank.		Oxner.	

* Silvol is a protein solution of nitrate of silver, manufactured by Parke, Davis & Co., Detroit, Michigan.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Flukes: <i>Uncyrocéphalus</i>	On gills.	Most viviparous species, also bass, sunfish and goldfish.	1 to 2% acetic acid for fish $\frac{2}{10}$ and under; $\frac{2}{10}$ for larger fishes.*	Immerse with a net $\frac{1}{2}$ to 1 min.	Embodry.	Almost 100% control.
<i>Lepidella melloni</i> , MacCallum.	First stage, eyes filmed over by flukes. Next, inflamed and beginning to bulge. Finally bulge and burst, and then cave in, leaving a white disc where eye was. Brown egg-strings hang from flukes.	Shadefish (<i>Chaetodon</i>), Angelfishes (<i>Pomacanthus</i>).	Silvered 10% solution.	Immerse fish in solution for 1 to 3 minutes.	Mellon.	Saved all treated before inflammation set in.
Gyrodactylasis caused by various species of <i>Gyrodactylus</i> .	The fluke bears living young which before birth contain the young of the third and fourth generation.	Experiments under microscope: Angrol of no avail, flukes liked it. Boric acid solution. Dakin's solution killed in 20 seconds but dared not use it on eye of fish. Silvered killed in 15 seconds.				1 tablespoon to 100 parts water.
Diseased fins.		Goldfishes (<i>Carassius auratus</i>), bluegill sunfishes (<i>Lepomis microlophus</i>), catfishes (<i>Ictalurus</i>).	Glacial acetic acid, 1 part to 500 parts water.	Immerse fish for 10 to 60 seconds.	Bangham.	Kills parasites.
Gills attacked.		Salt and fresh-water species. Trout (<i>Salmo trutta</i>), black anglers (<i>Salmo atra</i>), black angelfish (<i>Pomacanthus</i>), and porkfish (<i>Unisphærus argenteus</i>).	Formaldehyde, 40 cc. of a 10% solution to 10 gallons of water.	Immerse 8 to 15 min. according to actions of fish.	Chute.	Salt water species make better. Flukes let go, drop to bottom and can be gathered after fish is removed.
On fins.	Goldfish, brook trout, and most live bearers.		1/10% acetic acid for fish $\frac{2}{10}$ and under; $\frac{2}{10}$ for older specimens.	Immerse with net $\frac{1}{2}$ to 1 min.	Embodry.	Almost 100% control.

* 2% acetic acid solution is made as follows: 1 part 99% glacial acetic acid plus 495 parts water, or 1 part 30% glacial acetic acid plus 180 parts water.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
"	"	Trout.	Sulphuric acid .05 %.	Immerse 15 seconds.	Embrey.	Killed parasites instantly. After effect on fishes not known. They appeared not injured at time.
"	"	"	2 % acetic acid.	1 min. dip. Repeat in 2 weeks if necessary.	Embrey.	One treatment usually effective.
"	"	"	2 1/2 % solution acetic acid.	10 to 12 seconds.	Foster.	Kills parasites and does not injure fingerlings.
"	Ulcerated and broken fins. Ulcers on body. Irritations. Loss of appetite.	Eastern brook trout. (Salvelinus fontinalis). Rainbow trout. (Salmo irideus).	5 % salt solution.	Immerse for 1 1/2 to 2 1/2 min.	Guberlet.	Good.
"	"	Brook, brown and Loch-leven trout. (Salvelinus, Salmo larva, and S. leucomaenis).	1 part .99 % glacial acetic acid to 350 500 parts water, according to condition of fish. For fish less than 4" long, use 1 part acid to 500 750 parts water.	Immerse fish 30 to 40 seconds.	Hayford.	Cure.
"	"	Various fresh-water fishes.	Salicylic acid 1 % solution.*	Immerse fish 1/2 hour.	Hofer.	Cured.
"	"	"	Permanganate of potassium, 1 100,000.	?	Hofer.	Very effective.
"	"	?	2 % acetic acid (Dr. Embrey's formula).	Dip.	Moore.	Cure.
"	Diseased fins.	Pickered.	Formaldehyde, 20 cc. of 100 % solution to 20 gallons water.	Immerse fish 30 min. utes.	O'Brien.	Cure.
"	Gills attacked.	Rainbow trout (Salmo irideus).	Formaldehyde, 22 cc. of 100 % solution to 20 gallons water.	Immerse fish 15 min. utes. Repeat every 2 days until gills are cleared.	O'Brien.	Cure.

* Dr. Roth says this is too strong, and that 1 % parts in 100,000 parts water for 1/2 hour is correct.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
		?	Hydrogen peroxide .3% solution (3 parts to 1,000).	1 minute immersion.	Roth.	Flukes die in one minute.
	Gills attacked.	Goldfish.	Ammonia .05% for weak bath (5 cc. in liter) and .1% for strong bath (10 cc. in liter).	Immerse 5 to 20 minutes.	Roth.	Dissolves the mucus, thus relieving breathing and reaching parasites.
	Sticklebacks (<i>Phoxinus phoxinus</i>) and Bitterling (<i>Rhodeus amarus</i>) are more sensitive to ammonia.	?	Ammonium chloride 1.5 to 2.5% solution (15 to 25 grams in a liter of water).	Immerse for 5 to 10 minutes.	Roth.	Excites secretion of mucus instead of dissolving it, but effect on parasite is same as that of ammonia.
		Weatherfish (<i>Cobitis loxotilis</i>).	Potassium permanganate of potassium, 5 granules plus 1 gallon water.	Immerse 1 day.	Seale.	Cured.
<i>G. elegans</i>		Goldfish.	Formaldehyde.	Place fish in solution 5 drops to quart water. Add 1 drop a minute until have 10 to quart. Leave 10 min. unless previously exhausted. Repeat second and third day.	Innes.	Effective if fish is not too far gone.
		?	Glacial acetic acid, 1 part to 400 parts water. (Dr. Embury's formula.)	Place fish in solution 2 min.	Innes.	Kills parasites.
	Gills attacked.	American brook trout (<i>Salvelinus fontinalis</i>), Brown trout (<i>Salmo trutta</i>), and Rainbow trout (<i>S. irides</i>).	Ammonia, 8 drops to quart of water.	Immerse fish 2 min. and segregate. Four days later immerse 5 min. Sterilize exhibition tank.	Mellen.	Saved 67 out of 72 treated. Playful and pugnacious when returned to exhibition on fifth day. Still living many months later.

(Experiments under microscope: Flukes did not die for 40 minutes in 5% solution aluminum sulphate; nor for 30 minutes in solution formalin 20 drops to quart of water. Kerosene also ineffective. Ammonia 8 drops to quart killed in 2 minutes.)

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
<i>Micracodyle angelichthys</i> .	Parasites on gills.	Goldfish.	100 cc. of 2% mercurio-chrome, plus 50 gallons of water.	Immerse over night.	Seale.	Cured in 2 treatments.
<i>Micracodyle angelichthys</i> .	Whitening of gills caused by flukes sucking out blood.	French, Queen, Blue and Black Angel-fishes (<i>Pomacanthus</i> and <i>Angelichthys</i>).	Silvered 10% solution.	3 minute bath.	Mellen.	100% saved.
Fungus diseases: <i>Ahlya</i> , various sp. (Under microscope spine-like.)	Ulcers on body, gills livid, eyes coated and glazed.	Goldfish.	Salt.	Give bath in strong salt solution, or apply solution with swab, followed by peroxide swabbing.	Woff.	Effective.
<i>Suprilegma</i> , various sp. (Most often <i>S. ferax</i> .)	White, cottony tufts developing in wounds or on scales.	Mullet (<i>Mugil cephalus</i>).	Potassium permanganate in sea water very concentrated, 1:100.	Clean wound down to bony surface. Swab with solution. Repeat 3 or 4 times at intervals of several days.	Dida.	Rapid healing. Fish still living, 2 years.
		Black bass (<i>Micropterus</i>).	Copper sulphate, 1 part to 1,000,000 parts water.	?	Hofer.	Cure. Will not mature eggs or fry.
		Brook trout (<i>Salvelinus fontinalis</i>).	Permanganate of potassium.	Wash parts with 1% solution, using sponge, then put in bath of same, 1 gram per 100 liters.	Hofer.	Best remedy.
		Goldfish.	Strong salt solution.	Sponge body while submerged.	Mecham.	Generally effective.
			New York harbor water, specific gravity 1.012-1.013.	Dropped fishes in for from 5 min. to 2 hrs., according to resistance. Then placed in tank with flow half salt, half fresh water.	Mellen.	Saved 100 out of 105.
			Salt.	Bath in strong solution until fish shows distress.	Moore.	Cure.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
..	..	<i>Geophagus brasiliensis</i> , a fish living in impure and clayey water. Gets sick in clean water, sore spots, fungus.	Hydrogen dioxide neutral, not acid.	?	Moreira.	Indifferent.
..	..	Fresh-water species in general.	Salt water specific gravity 1.026-1.028.	?	Moreira.	Saves some but most die.
..	..	Pickered (<i>Exocoetidae</i>), small mouthed black bass (<i>Micropterus dolomieu</i>).	Salt and shade.	Immerse fish until it shows signs of distress, in solution 8 oz. to 20 gal., then place in darkened tank. Repeat every 2 days until cured, and exhibit in shaded tank.	O'Brien.	Cure.
..	..	Goldfishes	Kerosene	Drop fish into the oil for 4 $\frac{1}{2}$ min.	Peters.	Cure.
..	..	Fresh-water fishes in general.	Fusel oil, 30 drops to quart of water.	Place fish in solution 3 seconds.	Peters.	Cure.
..	..	Paradise fish (<i>Macropodus opercularis</i> and <i>varius</i>).	Mercuriochrome.	10 drops 2% solution to quart water overnight.	Seale.	Cured in 2 treatments.
..	..	Goldfishes.	Salt, epsom salt, phenol sodique. Use 1 teaspoonful each of table salt and epsom and 10 or 12 drops phenol sodique to 2 $\frac{1}{2}$ gal. water.	Place fish in solution and give it a jar or small flower pot in which to hide and rest. Keep out of sun, temperature 65-70° F. Food should be omitted for 2 days. If not cured in 2 days, paint fungused spots with coal oil or 50% solution peroxide of hydrogen, wash off, and return to same solution.	Wolf.	Cure in light case.

In the case of fungus on fresh-water fishes of large size such as carps, buffalofishes and giant gars, it is an old practice at the New York Aquarium to introduce small fishes into the tank to eat off the fungus. Sunfishes, roach and goldfishes do this work well, and giant gars left unmolested a company of pearl roach engaged in riddling them of *Saprolegnia*.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Gas	Fish becomes inflated from change of density or other unnatural conditions and cannot descend.	Large fishes of fresh and salt waters.	Strong needle, piercing.	Turn left pectoral fin forward and pierce behind it in a backward-upward direction.	General remedy.	Successful in many cases.
Gas-bubble disease. (Caused by air bubbles reducing water density sometimes <i>S. Baumei</i> .)	Generalized hemorrhage and protrusion of eyes. Kills in 24 hours.		Prevention lies in filtering water and stopping flow while milky appearance indicates presence of air bubbles.		Moraira.	
See Pop Eye, under Eye Troubles.						
Indigestion (also Constipation).	Abdomen swells, fish sluggish, standing on head or lying on bottom.	Goldfishes and others.	Castor oil, fasting.	Hold fish upright with wet rag around gills and drop oil down throat with medicine dropper. Omit food for 3 days or a week.	Old remedy.	Partly efficacious. Fish ejects most of the oil on being returned to water.
		All small fresh-water fishes.	Castor oil, fast, and change of diet. If fishes have been in small or crowded quarters, increase swimming space.	Drop fish in a cup or bowl of castor oil 2 minutes. Remove to another bowl until oil has risen from body. Drain off and return fish to aquarium. Omit food one week, then give moist foods—boiled oatmeal, custard, junket, boiled spinach.	Mellen.	Fish immediately responds by livelier actions and desire for food. Effect of oil apparent in excreta for several days.
		Goldfish.	Epsom salt, castor oil, earthworm.	Add epsom salt to water of aquarium and drop castor oil down throat of fish, repeating dose. Fresh earthworms are a laxative.	Wolf.	Cure.
Leech	White leeches are visible on fishes and glass of tanks.	Goldfishes.	Salt.	Inject strong solution in gills or give baths 1 oz. to gal. water, 2 days, then 2 oz. to gal., then back to 1 oz. to gal.	Innes.	Removes parasites.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Protozoan parasites; Black Fungus	Dark gray spots that turn black, peel and leave raw spots. Gill plates and sides of body affected.	Goldfishes.	Salt solution, 50% peroxide, Turlington's balsam.	Salt bath, 1 oz. to gallon water. Increase over 3 or 4 days to 2½ oz. to gal. Reduce strength slowly before returning to fresh water. Next paint spots with peroxide. Following day use Turlington's balsam. Feed daphnia and earthworm.	Imms.	If gills are not affected, there is a chance of recovery.
"	Black spots, no sores.	Goldfishes and yellow perch (<i>Perca flavescens</i>).	Salt and mud.	Gave swim in harbor water (salinity 1.013) as long as they could stand it, and transferred to mud bath for a week.	Mollen.	90% cured.
<p>Microscope revealed no parasites, and condition appeared to be merely a disturbance of pigmentation, due to general debility or blood disorder.</p> <p>Wolf says "Black fungus is usually Gyrodactylus and Myxidium."</p>						
Chilodoniasis caused by <i>Chilodon cyprinum</i> and <i>C. truttae</i> .	On gills and fins, sometimes causing small lesions and partial fusion of gills.	Goldfish, catfish, sunfish, all sp. trout, advanced fry and fingerlings.	1.10% acetic acid for fish 2" and under. 2 to 4% for older.	Immerse with net ½ to 1 min.	Embrey.	Almost 100% control.
"	Silvery, glassy scum. Slight irritation to skin. Sluggishness.	Tench (<i>Tinca</i>), Crappie (<i>Pomoxis annularis</i>), Suckers (<i>Catostomus</i>), Carp (<i>Cyprinus</i>), catfish, bass.	Salt.	Give bath in 2 to 2½% solution, 20 to 30 minutes. One or two treatments generally sufficient.	Giberlet.	Good.
"	Lie on side and refuse food. Slimy. Blue-white covering of mucus. Scales drop off, exposing denuded patches below. Gills finally attacked, then loss of appetite and death follow.	Brook trout (<i>Salvelinus fontinalis</i>).	Glacial acetic acid.	1 part 90% glacial acetic acid to 350 500 parts water according to condition of fish. Specimens under 4" long, 1 part to 500-750 water.	Hayford.	Cure.
"	"	"	2% salt solution.	Bath 15 to 30 min.	Hofer.	Cure.
"	"	Carp, goldfish, trout.	2 to 2½% solution salt.	Give one or two 20 min. ute baths.	Moore.	Cure.
"	"	"	1-2000 copper sulphate (Dr. Davis' formula).	Dip one minute.	Moore.	Cure.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Costiasis (caused by <i>Costia</i> <i>neubarii</i>).	Slimy skin, irregular opaque spots which finally unite and cover entire body. Para- sites embed in layer of mucus, fatal to young fish in a few days, adults suffocate when gills are at- tacked.	Brook trout (<i>Salvelinus</i> <i>fontinalis</i>).	Glacial acetic acid 1 part .09% gaaa. to 350 500 parts water according to condi- tion of fish. Specie- mens under 4" long, 1 part gaaa. to 500 750 parts water.	Immerse 30-40 seconds.	Hayford.	Cure.
"	"	Goldfish, rainbow trout (<i>Salmo irideus</i>), carps (<i>Cyprinus</i>), <i>Tilapia</i> .	1 2000 copper sulphate.	Dip one minute.	Moore.	Cure.
"	"	"	Salt solution. 2 1/2 % (Hofer's formula) 21 lbs. of salt to 100 gallons of water.	4 baths at intervals of 3 days each. Dip for to 30 minutes ac- cording to resistance of fish, and add salt to tank water.	Moore.	Cure.
"	"	Aquarium fishes.	Formalin .025% solu- tion.	Immerse 1/2 hour if nec- essary.	Roth.	Surest remedy. Parasites suc- cumb in even .02% in about 1 min.
Chylochoetiasis (caused by <i>Chylo-</i> <i>choeta domerguei</i>).	Silvery glossy scum on body. Irritation and later sluggishness.	Tench (<i>Tinca</i>), crappie (<i>Pomoxis annularis</i>), suckers (<i>Catostomus</i>), carp (<i>Cyprinus</i>), cat- fish and large mouth bass (<i>Micropterus sal-</i> <i>moides</i>).	2 2 1/2 % salt solution.	In bath 20 or 30 min. One or two treat- ments generally suf- ficient.	Guberlet.	Good.
"	Opacity of skin (in young eels it acts white) which finally extends to whole body. Death is quick.	Aquarium fishes only. Eels, Cyprinidae, Sal- monidae.	1 3 1/2 % salt solution.*	Bath 1/4 to 1/2 hour. Re-Hofer. Repeat every second day.	Re-Hofer.	Fishes entirely freed from parasites.

* Dr Roth considers this a misprint, claiming that undiluted sea water contains only 2% to 3 1/2% salt.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Ichthyophthiriasis (caused by <i>Ichthyophthirius multifiliis</i>). Also called White Spot Disease, and Ich.	Body dotted with white specks, which are pits eaten through the scale pigment by protozoan parasites that soon occupy every scale. Followed by inflamed and sore areas in which <i>Suppoea</i> takes root. Also in gills and mouth but not beneath epithelial layer of skin. Fish becomes slimy, refuses food, becomes quiet and depressed and dies in a few weeks.	Small, fresh-water species, balanced aquarium size.	2% mercurochrome solution.	5 drops to gallon water for 5 days, renewing each day.	Adams.	Cure.
		About 20 species of Ohio fishes including goldfish, catfish, large and small mouth basses.	Aluminum sulphate.	3% solution 2 min. bath for young fish. 5% sol. 2 min. bath for adult fish. 5% sol. 1 min. bath for young bass.	Bingham.	Satisfactory. Killed parasites.
		(Fishes will lose parasites if planted in a swift stream.)				
		Carp (<i>Cyprinus</i>), Rudd (<i>Scardinius erythrophthalmus</i>) and Tench (<i>Tinca</i>).	1 to 10,000 copper sulphate solution.*	15 min. bath in 18" of solution. Then into water until a 4' tank is full, taking 8 hours. Then siphon to waste and fill with water from normal circulation. Keep specimens in dark.	Boulenger.	Cured 99% carp
		(Goldfishes and small fresh-water species.	Heat and change of water.	Use water 85° to 90° changing every 8 hours and putting fishes in different sterilized container at each change, i.e., using two containers alternately. Takes several days.	German method.	Satisfactory results.

* Barbel, chubb and perch are killed by this solution.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
"	"	Steelhead trout (<i>Salmo gairdneri</i>), Rainbow trout (<i>S. irideus</i>), catfish, sickleback, crappie, bass.	Running water.	In troughs.	Gilbert.	Fail.
"	"	Rainbow trout (<i>S. irideus</i>).	Swift stream.	Remove fish to swift running water.	Hayford.	"
"	"	Basses, sunfish, 5 to 12" in length.	Bicarbonate of soda, strong solution.	Apply with paint brush. This causes mucus coating to slough off, taking parasites with it. Treat 3 times in 10 days or 2 weeks, keeping fishes segregated in 5" of running water.	Harron.	Cure.
"	"	Rainbow trout (<i>Salmo irideus</i>).	Swift stream.	Remove fish to swift running water.	Hayford.	Cure.
"	"	Goldfish.	Quickly flowing water is the only cure.		Hofer.	Cure.
"	"		Kerosene.	Dip cheesecloth in coal oil and wipe each side of body and both sides of fins. Then 5 seconds' complete immersion. Rinse in plain water and return to aquarium next day, wiping any spots that were missed.	Innes.	Effective.
"	"	White bass (<i>Micropterus dolomieu</i>).	Household ammonia, 8 drops to gallon of water.	Immerse fish in solution for 1 min., repeating daily until spots are cleared and keep in flowing water, half fresh, half salt (specific gravity 1.043).	Mellen.	Successful if fishes are kept in quiet, shaded tank and fed live food.
"	"	Chiefly Characidae and Siluridae of American fresh waters.	Neutral hydrogen dioxide.	?	Morira.	Poor success.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
..	Common salt, specific gravity 1.026 to 1.028 (practically sea water density).	Keep fish in solution until it displays uneasiness. Repeat daily or alternate days.	Morera.	50% cured.
..	..	Calico goldfish and <i>Poecilia reticulata</i> .	Alcohol solution 2 cc. to 5 cc. water and salt, 2 oz. to gallon of water.	Bathe affected parts with alcohol solution on soft cloth, protecting gills and eyes. Then give salt bath for 20 min. Repeat if necessary.	O'Brien.	Cure.
..	..	Walleyed pike (<i>Stizostedion vitreum</i>) and other fresh-water fishes.	Pure grain alcohol, 1 part to 2 parts water. Salt.	Dab on with rag from gills down. Then apply a salt solution. Repeat if necessary.	O'Brien.	Cure.
..	..	Carp, catfish, bass, sunfish, killies, bream, pike, trout, buffalo, bowfin, crappie, white bass, goldfish, white fish, pickerel, pike perch.	5% aluminum sulphate.	1 min. bath.	Prytherch.	Holds disease in check, killing parasites on fish.
..	3% aluminum sulphate (4 oz. to gal. water).	Brush on affected parts with saturated cheese-cloth or brush, first laying fish in shallow pan with 1/2" of solution in bottom.	Prytherch.	..
..	Tadpoles and salt.	Place fish in swiftly running water, no sand or dirt on bottom of tank. Siphon off bottom daily. Use tablespoon of salt to each gallon alternate days. Tadpoles eat parasites. Sterilize nets and siphons.	Prytherch.	Kills and removes parasites that leave fish.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
			Sterilization of tanks and change of water every two days.	Remove fish, swabbing sides and bottom of tank with brine. Rinse tank and refill with clean water. Replace fish. Apply for 10 days in warm weather.	Prytherch.	This is the best method as it kills and removes the parasites before they can multiply and reinfect the fish.
			Permanent salt bath.	Begin with .7% solution (7 grams to liter of water about 1 teaspoonful to quart) and strengthen every 24 hrs. until solution is 1.5%.	Roth.	Leave fish in until cured.
		Goldfish.	Bicarbonate of soda, 2 level teaspoonfuls to quart of water.	Immerse for 2 min. Repeat next day, 3 min. Repeat following day, 5 min. Change to fresh water after each treatment and on fourth and fifth day.	Scale.	Cured in 5 days.
		Trout, Catfish (<i>Ameiurus abditus</i>).	Methylene blue, 1% aq. sol. 50 cc. fresh-water 22-24° C.	Fishes left in solution 11 days.	Stiles.	Cured, all parasites having fish are killed in 12 min.
			Salt, 25 lbs. at bottom of a 4' tank. Constant supply of fresh water running in with as little commotion as possible, 23.5° C.	Fishes must be left in more than 2 weeks.	Stiles.	Fishes dive down in salty areas; parasites leaving fish for bottom are killed on reaching salty water. Infection lessened greatly in 2 weeks.
			Eosin, 1% aq. sol. 60 cc. fresh-water 10 L. constant aeration, 23° C.	Fishes kept in solution 5 days, when an accident ended the experiment.	Stiles.	Kills free protozoa in 10 to 60 min. At end of 5 days parasites were lessened in number.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Myxidium		Goldfish.	Parasiticide. Surgery. Monsell's salt. Phenol sodique. Peroxide of hydrogen. Coal oil. Turlington's balsam.	If parasiticide unsuccessful, cut off fins and tail where affected, scrape spots on body. Paint with Monsell's salt and keep fish in salt solution, adding phenol sodique 10-12 drops to gallon. Also pencil parts with 50% solution peroxide. If fish survives 2 days, paint parts with coal oil after cleaning with salt water or peroxide. Turlington's balsam will be greatly beneficial if fish survives healing stage. Give animal food.	Wolf.	
		<i>Salmo roseus</i> .	Epsom salt and salt, 1 tablespoon epsom plus 2 tablespoons salt to 1 gallon water.	Immerse for 3 days with slight spray of fresh water entering tank.	Seale.	Cured.
Myxosporidia.	Body speckled with black.	Pikes (<i>Esox lucius</i>) and wall-eyed pikes (<i>Silvestodon vitreum</i>).	Household ammonia, 8 drops to quart of water.	1 min. immersion, three or four baths 3 days apart.	Mollen.	Cured.
	Entire body clouded over and bright colors gone. No appetite. listless, lying on bottom of tank. Lateral line organ apparently not functioning.	Large comet gold-fishes.	Kerosene oil.	Drop fishes in the oil 1 min. Then place in tank with fresh and salt water (latter specific gravity 1.013) flowing in, 2 weeks.	Mollen.	100% cure. All returned to exhibition in 2 weeks, with bright colors.
Sporozoon?						
Oortomiasis		All young trout.	1 part 90% glacial acetic acid to 450 500 parts water according to condition of fish. Specimens under 1 1/2" part g.a.a. to 500 750 parts water.	Immerse 30-40 seconds.	Hayford.	Not a certain cure. If cod liver oil and thick sour milk are added to diet, there is less trouble with this disease.
	Caused by <i>Oortomias salmone</i> a protozoan with 8 flagella. Also called Whirling Sick-ness and Gill Trouble.					

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
Skin Diseases: Skin disease?			No medicine will cure. When infected fishes are held in temperature of 40° to 45° with abundant oxygen and no overcrowding, there is very little loss.		Davis.	
	White froth or foam mass.	Fancy goldfishes.	Sea water	Bath for slight attack, 15-20 seconds.	Dida.	Good.
			Potassium permanganate in fresh water 1-1,000.	Swab lightly the affected spots. Repeat. Keep gills away from solution.	Dida.	Good.
	Inflamed areas on sides of fish.	Goldfishes, carps, Yellow perch (<i>Perca flavescens</i>). Badly affected.	Turpentine and 50% peroxide.	Dip into turpentine from gills backward, then into peroxide. In case of yellow perch, follow with mud bath for two months.	Mellen.	80% cured.
		Goldfishes, lightly affected.	Aluminum sulphate, 1 oz. to gallon water.	Give bath, one to 3 minutes according to condition of fish.	Mellen.	Cured 405 out of 397.
Skin and scale disease (very contagious).		Labridae	Permanganate of potassium, 1-1000. Only real remedy is to remove immediately and to other specimens.	Swab with cotton soaked in solution.	Oxner.	Only partly successful.
Swim Bladder Trouble.	Loss of equilibrium; fish lies on side or back, or floats upside down.	Chinese goldfish in first and second year show trouble in development of swim bladder.	Orthopedic treatment.	With bits of string, attach a little lump of lead to lower part of body.	Dida.	Restores equilibrium but cords forming harness infect epidermis and prevent continuation of treatment.
		A <i>Centricus</i> , 60 centimeters long. Salt water fish from 200 fathoms. Weakened by rapid change in pressure.		(Applied for a fortnight.)	Dida.	Swam correctly in harness and was cured in a fortnight. Tough skin showed no trace of injury from harness, layered 4 months.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
		Chinese goldfish, weakened by winter hibernation.	Buoys	Attach a bent pin to dorsal fin, tying this to a bit of floating wood.	Gillis.	Cure.
	Swim bladder distended.	?	Squeeze and massage until air is expelled.		O'Brien.	Cure.
		Lake sturgeon (<i>Acipenser rubicundus</i>). Specimens weakened by bath in permanganate of potassium solution.	Keeling.	Force a current of fresh water through gill chambers by placing hose in fish's mouth. Pump heart region. Tie fish to piece of light iron piping. Length of fish, to serve as keel, 5 hours. Then tie a small coil of metal wire below body in front of pectorals to replace heavy pipe, 24 hours.	Parr.	Cure.
		Goldfish.	Try same remedy as for constipation.		Wolf.	
Wounds and Cuts.		?	Silver nitrate.	Apply to cut.	Chute.	Cure.
	Torn scales.	Salt water fishes.	Potassium permanganate in sea water 1 gramme to 1000.	Bathe 3 minutes stroking injured spots gently. Protect gills. Repeat several times, one day apart.	Dida.	Heals.
	Hole in flesh, followed by ulcer.	Fresh-water angelfish (<i>Pterophyllum scalare</i>)	Iodine and aconite.	Apply with absorbent cotton swab.	Innes.	A few treatments suffice.
		Goldfish—light case.	Weak salt bath. Then paint with Turlington's balsam.		Meehan.	Generally efficacious.

DISEASE	SYMPTOMS	FISH	REMEDY	HOW APPLIED	BY WHOM	RESULTS
"	"	Goldfish severe case.	Dioxogen or permanganate after salt.	Wash off fish with dioxogen or give a short bath in mild solution of permanganate or potassium after salt bath and sponging.	Moehan.	Generally efficacious.
"	Torn scales and cuts.	Fresh-water fishes.	Permanganate of potassium, saturated solution.	Pour on wounds, protecting gills with moist cloth. Wash off in fresh water and return to tank.	Mellen.	No infection will set in if this treatment is used in time.
"	Torn scales.	Fresh-water fishes.	Kerosene oil, and aluminum sulphate (1 oz. to gal.)	Drop fishes in oil 1 to 3 min. according to individual resistance. One week later give bath in aluminum sulphate.	Mellen.	Decidedly effective.
"	Torn lips and throats, specimens having been hooked.	Codfish (<i>Gadus callarias</i>).	Silvol, 10% solution.	Swab on cuts, with cotton wadding. Repeat on 3 days succeeding.	Mellen.	Complete cure all cases.
"	Torn lip.	Jewfish (<i>Promicrops guttatus</i>).	Potassium permanganate, 3 to 1 solution.	Apply to affected part.	O'Brien.	Cure.
"	Loss of scales and bruises.	Goldfish.	Salt water, phenol solution or peroxide. Turlington's balsam.	Clean injured parts with salt water, then apply either phenol solution or peroxide of hydrogen. Then treat abraded spots with Turlington's balsam to keep water from wound.	Wolf.	Almost always effective.

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